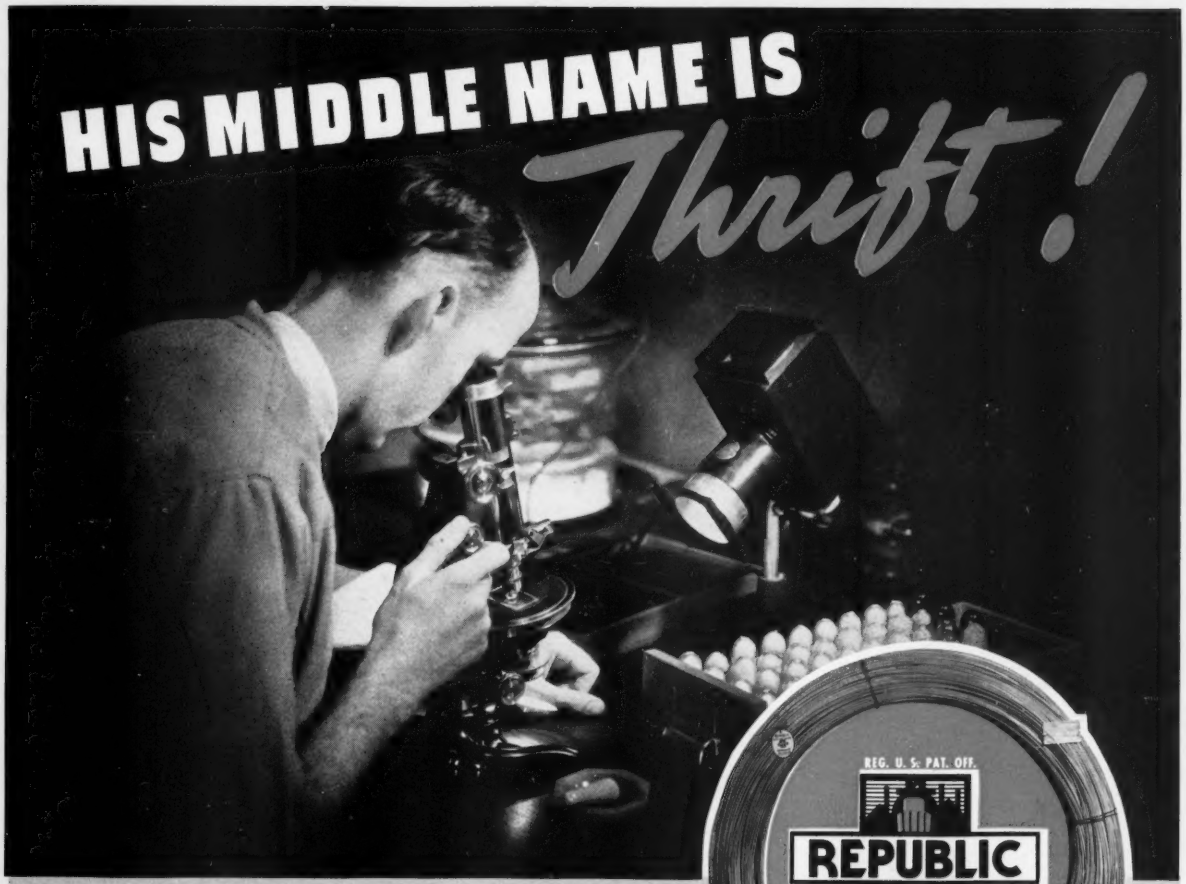
WIRE AND WIRE PRODUCTS

FEBRUARY 1939



● Every Republic metallurgist's middle name might well be "Thrift". It's his job to think constantly of savings for Republic customers — by providing them with better steel products and helping them to find short-cuts in fabrication.

Accept this as your invitation to use Republic's metallurgical staff — in finding thrifty answers to strength, temper, crimping and knotting quality and other fabricating requirements — in obtaining better wire that improves products and cuts costs. Republic Steel Corporation, Wire Division, 7850 So. Chicago Ave., Chicago, Ill. — General Offices, Cleveland, Ohio.

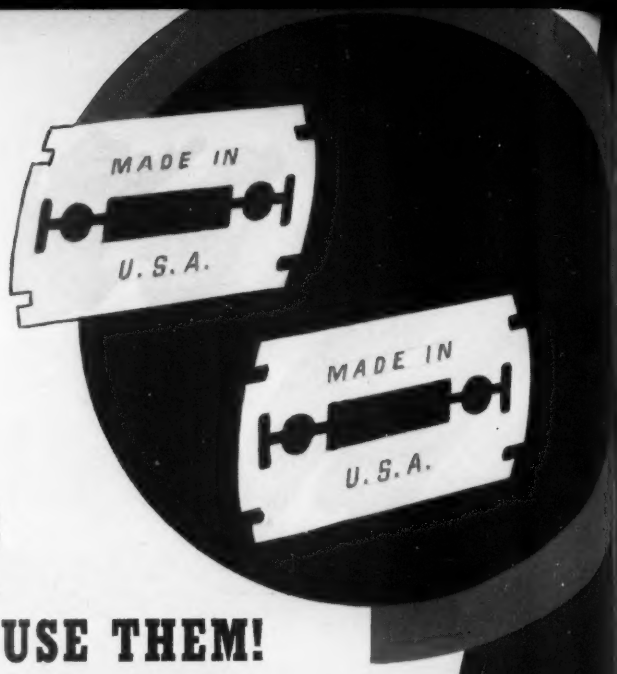
BERGER MANUFACTURING DIVISION

NILES STEEL PRODUCTS DIVISION • TRUSCON STEEL CO.

UNION DRAWN STEEL DIVISION • STEEL AND TUBES, INC.

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

They Look alike



BUT THE DIFFERENCE

SHOWS UP WHEN YOU USE THEM!

All wire looks much alike. But put it to the test of steady production and there's as much difference as there is in razors, motors -- or human beings.

Youngstown's progress in your industry depends on making wire so much better that you will want it and use it. That's why we have one of the most efficient wire mills in the steel industry--why we have a crew of inspectors noted throughout the industry as "cranks" -- why we use selected steel for Youngstown wire.

These and other Youngstown special practices explain why, in wire plants from coast to coast, Youngstown Wire helps make better production at a higher rate and a lower cost.

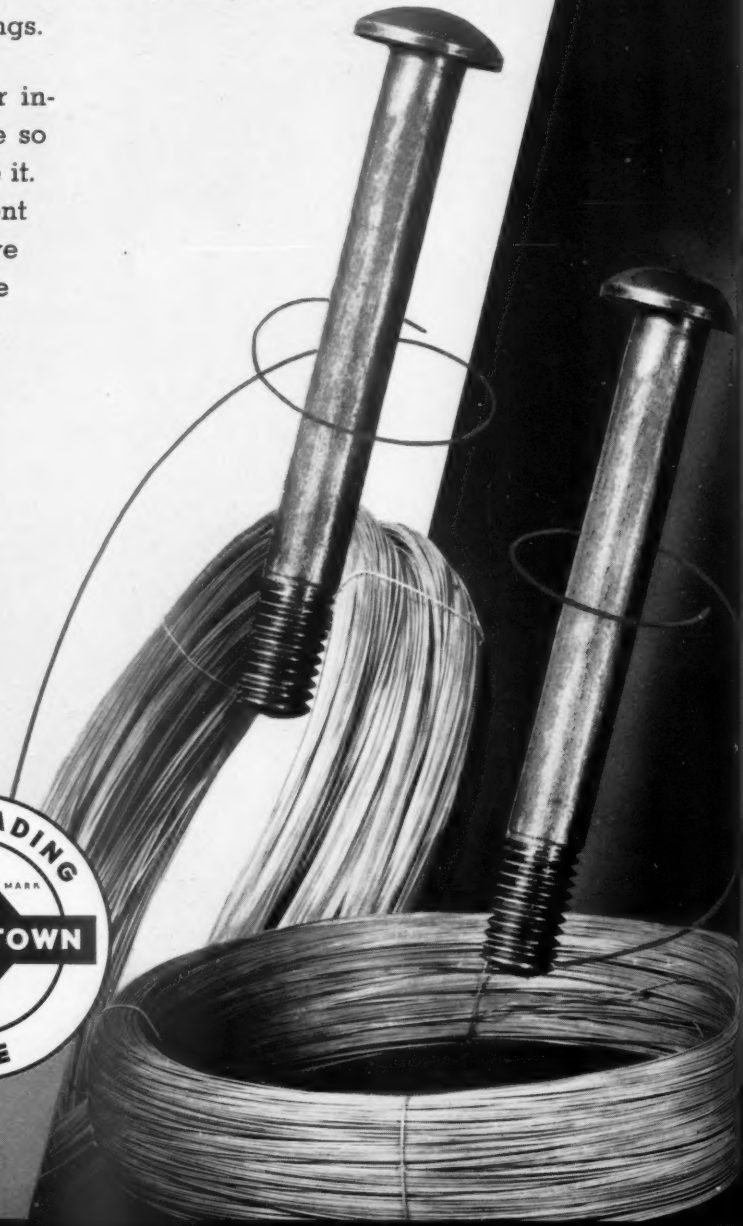
THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon and Alloy Steels

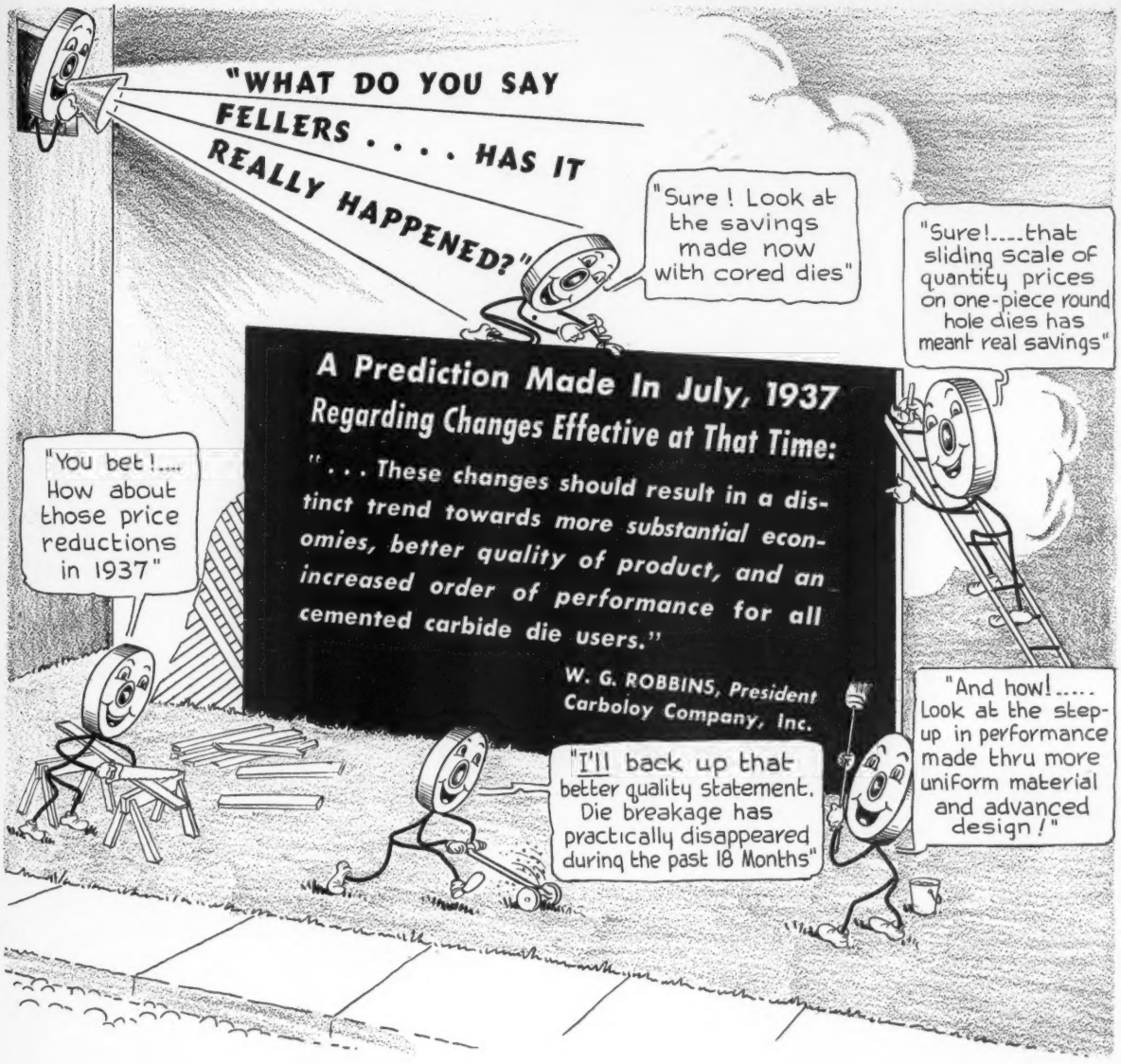
General Offices - YOUNGSTOWN, OHIO

Wire - Pipe and Tubular Products - Sheets - Plates
Conduit - Tin Plate - Bars - Rods - Nails - Unions
Tie Plates and Spikes.

14-2A



YOUNGSTOWN


"WHAT DO YOU SAY FELLERS . . . . HAS IT REALLY HAPPENED?"
"Sure ! Look at the savings made now with cored dies"
"Sure!....that sliding scale of quantity prices on one-piece round hole dies has meant real savings"
A Prediction Made In July, 1937 Regarding Changes Effective at That Time:
". . . These changes should result in a distinct trend towards more substantial economies, better quality of product, and an increased order of performance for all cemented carbide die users."
W. G. ROBBINS, President Carboloy Company, Inc.
"You bet!.... How about those price reductions in 1937"
"I'll back up that better quality statement. Die breakage has practically disappeared during the past 18 Months"
"And how!..... Look at the step-up in performance made thru more uniform material and advanced design!"

We wish to renew that objective for the future as part of our long range program to reach the ultimate in service to the cemented carbide die user.

The Mark of CARBOLOY
REG. U. S. PAT. OFF.

CARBOLOY COMPANY, INC.

DETROIT, MICHIGAN

CHICAGO • CLEVELAND • NEWARK • PHILADELPHIA • PITTSBURGH • STAMFORD, CONN. • WORCESTER, MASS.

Authorized Distributors:

Hartley Wire Die Co., Waterbury, Conn • • • Canadian General Electric Co., Ltd., Toronto, Canada

CARBOLOY DRAWING AND SIZING DIES

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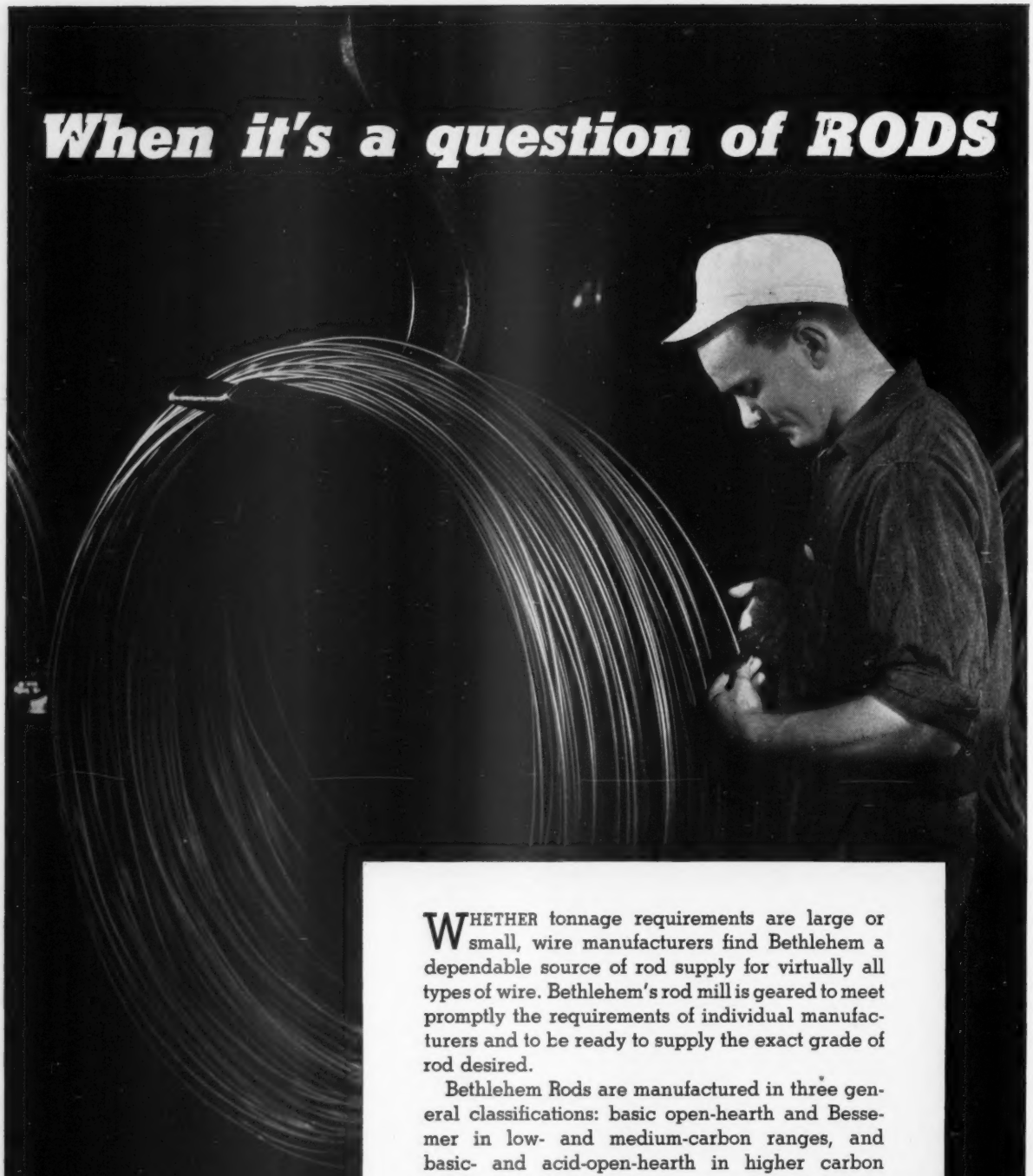
When it's a question of RODS

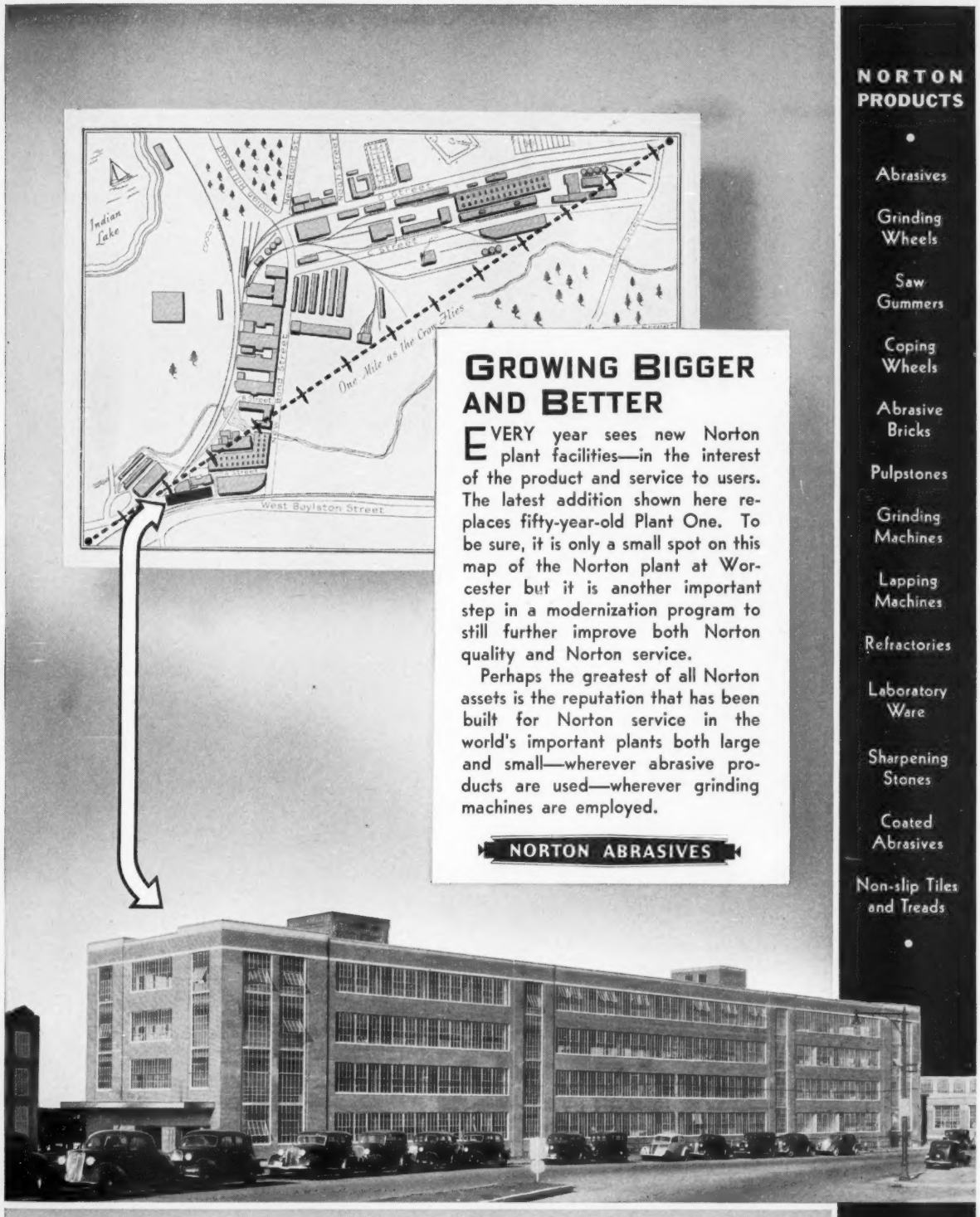


WHETHER tonnage requirements are large or small, wire manufacturers find Bethlehem a dependable source of rod supply for virtually all types of wire. Bethlehem's rod mill is geared to meet promptly the requirements of individual manufacturers and to be ready to supply the exact grade of rod desired.

Bethlehem Rods are manufactured in three general classifications: basic open-hearth and Bessemer in low- and medium-carbon ranges, and basic- and acid-open-hearth in higher carbon ranges. Rods in all analyses are made within these general classifications, providing material for wire of practically every description.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY



GROWING BIGGER AND BETTER

EVERY year sees new Norton plant facilities—in the interest of the product and service to users. The latest addition shown here replaces fifty-year-old Plant One. To be sure, it is only a small spot on this map of the Norton plant at Worcester but it is another important step in a modernization program to still further improve both Norton quality and Norton service.

Perhaps the greatest of all Norton assets is the reputation that has been built for Norton service in the world's important plants both large and small—wherever abrasive products are used—wherever grinding machines are employed.

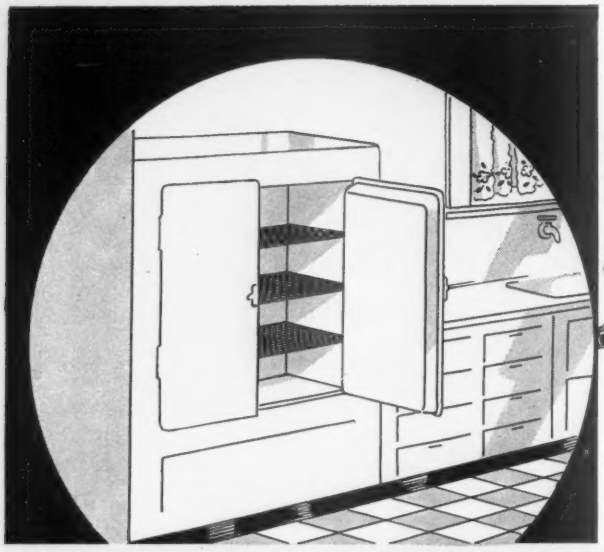
NORTON ABRASIVES

NORTON PRODUCTS

- Abrasives
- Grinding Wheels
- Saw Gummers
- Coping Wheels
- Abrasive Bricks
- Pulpstones
- Grinding Machines
- Lapping Machines
- Refractories
- Laboratory Ware
- Sharpening Stones
- Coated Abrasives
- Non-slip Tiles and Treads

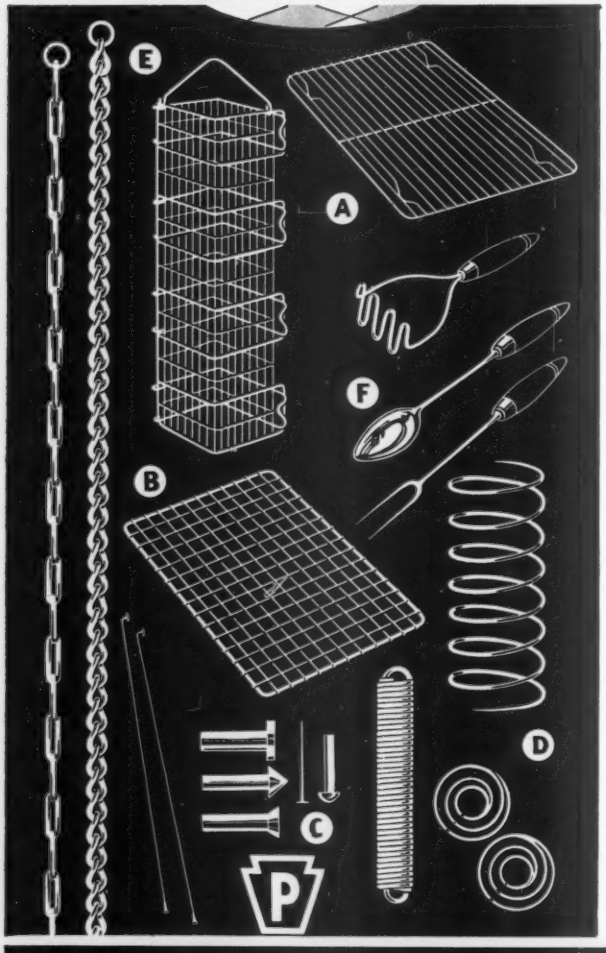
NORTON COMPANY • WORCESTER, MASSACHUSETTS, U. S. A.

New York · Chicago · Detroit · Cleveland · Pittsburgh · Philadelphia · Hartford
Hamilton, Ont. · London · Paris · Wesseling, Germany · Corsico, Italy
BEHR-MANNING DIVISION, TROY, N. Y.



In the inaccessible jungle and elsewhere, Pittsburgh Stainless Steel Wire, in messenger cable and cable ties, masters corrosion. Greater strength, less weight and freedom from corrosion eliminate most maintenance troubles.

IN MODERN KITCHEN OR STEAMING JUNGLE···



STAINLESS WIRE

Wins its way!

Your product will be both better and more saleable if vital parts are "Stainless." When resistance to corrosion, greater strength with less weight, and beauty with utility, are desirable . . . choose PITTSBURGH Stainless Steel Wire, unhesitatingly. It fabricates readily. Difficult jobs of weaving, machining, welding and cold heading easily yield to PITTSBURGH'S unusual workability. Write for information.

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1641 GRANT BUILDING · PITTSBURGH, PA.

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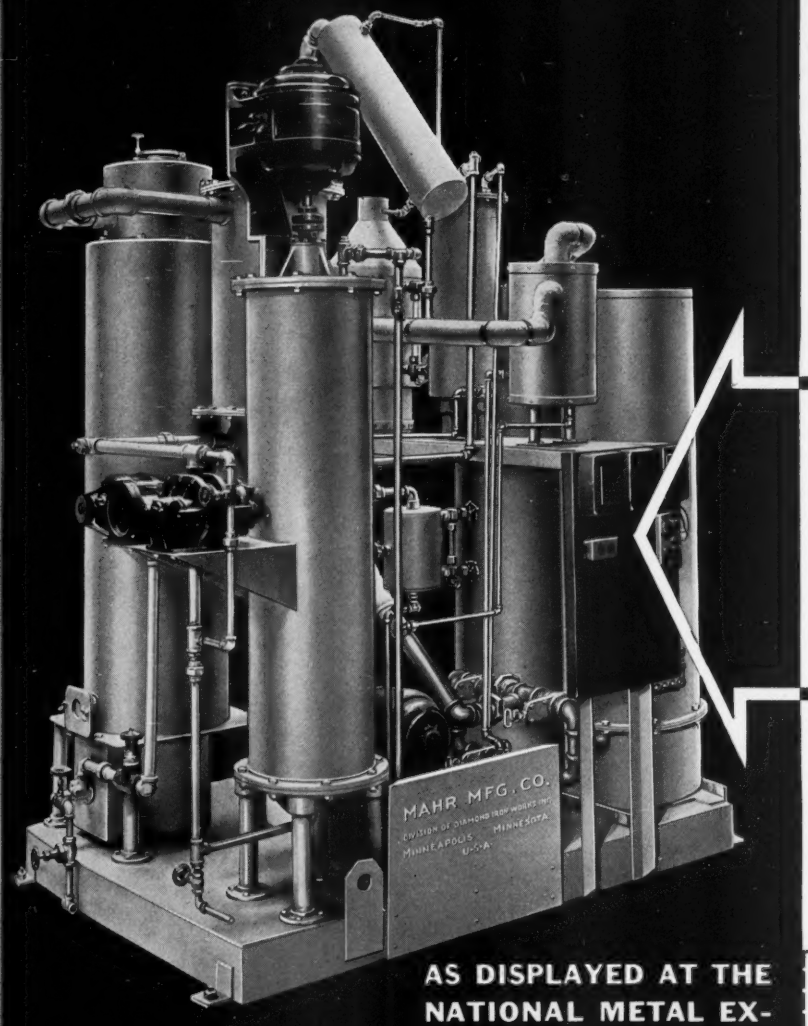
Pittsburgh Stainless Wire

NITROGEN

Ideal for Protective Atmospheres

AT EXTREMELY LOW COST



AS DISPLAYED AT THE NATIONAL METAL EXPOSITION AT DETROIT

MAHR

Vitally awake to industry's needs, Mahr has produced a ***NITROGEN GENERATOR*** so new, so practical and compact that the answer to the problem of low cost Nitrogen is here. Non-toxic, non-explosive, and chemically inert even at elevated temperatures, Nitrogen is the ideal protective gas.

HERE IS *CONTROLLED* N_2

At finger tip control Nitrogen can now be produced of UNEQUALLED PURITY and at LOW COST. A generator capable of being adjusted to maintain the desired analysis, either neutral, oxidizing or reducing in any degree.

So many are the applications and possibilities of this new generator that space here does not permit explanation. Send coupon below for detailed descriptive literature.

• REPRESENTATIVES IN ALL INDUSTRIAL CITIES

MAHR

ENGINEERS • DESIGNERS • MANUFACTURERS
ALL EQUIPMENT FOR METAL HEATING

GAS • ELECTRIC • OIL

MAHR MANUFACTURING COMPANY
DIVISION OF DIAMOND IRON WORKS, INC.
MINNEAPOLIS, MINNESOTA, U. S. A.

Gentlemen:

Kindly mail us (at no obligation) further information and literature regarding the MAHR NITROGEN GENERATOR. ☐ Check

We are interested, and would like your nearest representative to call on us regarding the generator. ☐ Check

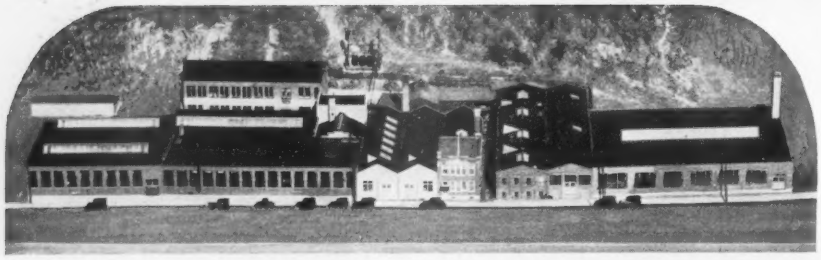
Yours very truly,

_____
COMPANY NAME

_____
ADDRESS

_____
INDIVIDUAL NAME

_____
TITLE



Fine Wires Finely Made

HUDCO

Wires for Metal Spraying

Pure Lead
Lead Alloy
Pure Zinc
Zinc Alloy
Copper
Tin
High Brass
Low Brass
Solder Wire
Cadmium
Nickel Silver (10%, 18%, 30%)
Aluminum
Monel Metal
Phosphor Bronze
Pure Nickel
Commercial Bronze

* * *

High Conductivity Electric Wire

* * *

Brush Wires, Crimp and Straight (Brass, Steel, Nickel Silver, Copper and Phosphor Bronze)

HUDCO

Fine Bare Wires

High Brass
Low Brass
Zinc 99.99 and High Tensile Zinc
Commercial Bronze
Phosphor Bronze
Pure Tin
Lead
Antimonial Lead
Cadmium
Nickel Silver, 10%, 18%, and 30%
Silver Plated Copper
False Gold and Special Brass and Bronze Alloys to Specification

* * *

Tinsel Lahns, Silver Plated Copper, False Gold and Copper

* * *

Metallic Fibre For Packing Purposes, Copper, Bronze, Zinc, Lead and Aluminum

WINCO

Leakproof Enameled Wires drawn from special oxygen-free copper. There are no oxide inclusions which produce surface defects such as slivers. Perfect enameling is assured. Every foot is mercury-tested before shipment.

* * *

The Winco line of wires also includes enameled wires in all standard and special coverings made to meet exacting requirements.

* * *

Samples of Leakproof and other Winco Enameled Wires sent on request.

HUDSON WIRE COMPANY

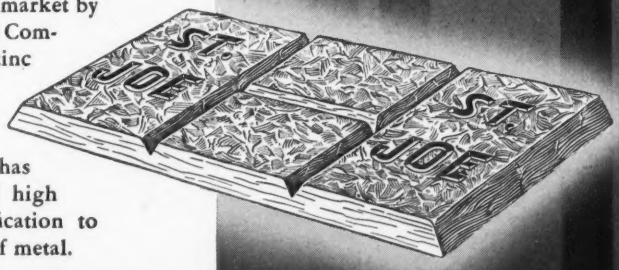
OSSINING, N. Y.

ESTAB. 1902 — Successors ROYLE & AKIN — ESTAB. 1902

THE WELL KNOWN NAME IN LEAD IS NOW A FACTOR IN ZINC

● The St. Joseph Lead Company is the largest miner of lead in the country, and the name ST. JOE has been synonymous with lead since the organization of the Company in 1865.

In November, 1928, Bunker Hill produced the first 99.99+% zinc in commercial quantities. This zinc was placed on the market by the St. Joseph Lead Company. Today all zinc die-casting alloys are based on 99.99+% zinc, and the A. S. T. M. has adopted a special high grade zinc specification to cover this grade of metal.



In 1936 the St. Joseph Lead Company started the production of zinc metal at their Josephtown, Pa., plant. Here, ores from the company's mines at Edwards and Balmat, N. Y., are converted by a patented electro-thermic process into slab zinc. Today, the St. Joseph Lead Company has a zinc for every purpose:

- **BUNKER HILL SPECIAL HIGH GRADE**
- **ST. JOE HIGH GRADE**
- **ST. JOE INTERMEDIATE**
- **ST. JOE PRIME WESTERN**

ST. JOSEPH LEAD CO.

250 PARK AVENUE · NEW YORK

Tel. ELdorado 5-3200

PLANT AND LABORATORY

JOSEPHTOWN, BEAVER COUNTY, PA.

THEY ARE DOING IT

Morrison FLASH Bakers — Taking No More Space Than a Cleaning Tank — Are Turning Out More Than 10 Pin Loads of Rod Per Hour.

Here are some rod baking facts too important to ignore—facts taken from actual service performance of Morrison Flash Bakers. Rod baking has now become a part of the continuous cleaning cycle. It requires only six minutes or less. It takes place right in the cleaning line or circle. It is done in a tank-sized unit without removing rod from the hook.

Coils receive more uniform drying in a Morrison Flash Baker than by any other means. Permanent recovery from acid brittleness is in the range of 95 percent. Working condition of the rod is absolutely consistent.

Morrison Flash Bakers turn in savings from several angles: space, time, and fuel economy; convenience, and improved production. They are *doing* this in many mills today. Let them do it in yours too.

Morrison Flash Bakers protected by U. S. Patent No. 1,999,513.
Other patents pending. Trade Mark registered.

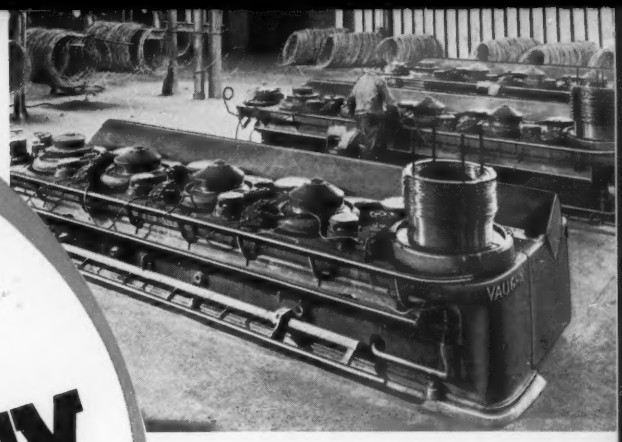
MORRISON ENGINEERING COMPANY, INC.

5005 EUCLID AVENUE — CLEVELAND, OHIO

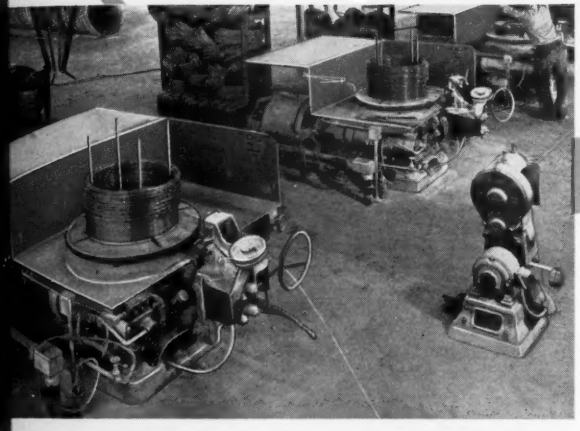
MORRISON ENGINEERED

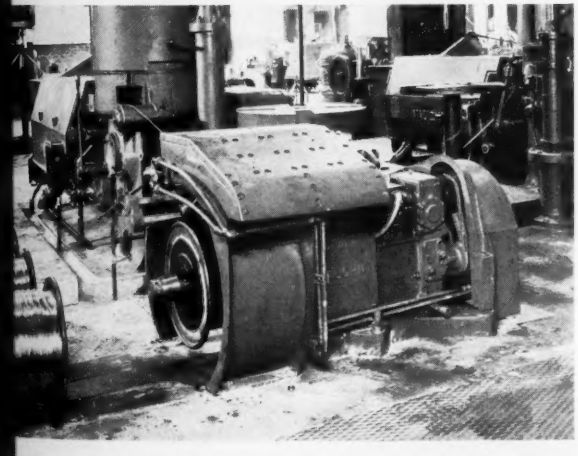
IF IT'S A FLASH BAKER - MORRISON BUILT IT

INCREASED PRODUCTIVITY



TODAY'S NO. 1 PROBLEM FOR WIRE MILL EXECUTIVES!





How to maintain a profit margin . . . with rising costs and shortened hours that cannot be compensated for by higher selling prices? What can you do but develop *a higher production factor* for every wage dollar paid . . . for every man-hour worked! *Increased productivity* today means more efficient machines and methods, and is the only loophole left for the manufacturer who intends, not only to survive, but to *grow* in these times.

A number of progressive Mills are satisfactorily meeting this situation by installing new, modern wire-drawing equipment—or by realigning present facilities for faster, more profitable handling.

In many cases Vaughn has been a central figure in these discussions . . . why not let a Vaughn engineer cooperate with you, too?

THE VAUGHN MACHINERY CO.
CUYAHOGA FALLS, OHIO

VAUGHN
WIRE DRAWING MACHINERY

COMPLETE
WIRE DRAWING EQUIPMENT
•
CONTINUOUS OR SINGLE HOLE
•
FOR THE LARGEST BARS
•
FOR THE SMALLEST WIRE
•
FERROUS, NON-FERROUS
MATERIALS OR THEIR ALLOYS

High Speed Economy

·WIRE DRAWING MACHINES·

For Non-Ferrous Wire in Coils —
Strictly Modern in Every Respect

SIZES AND EQUIPMENT AS SPECIFIED

MOTOR DRIVE: With or without friction clutch control.

WIRE BLOCKS: Plain or stripper type; interchangeable for diameter; provision for rotation in either direction, if desired.

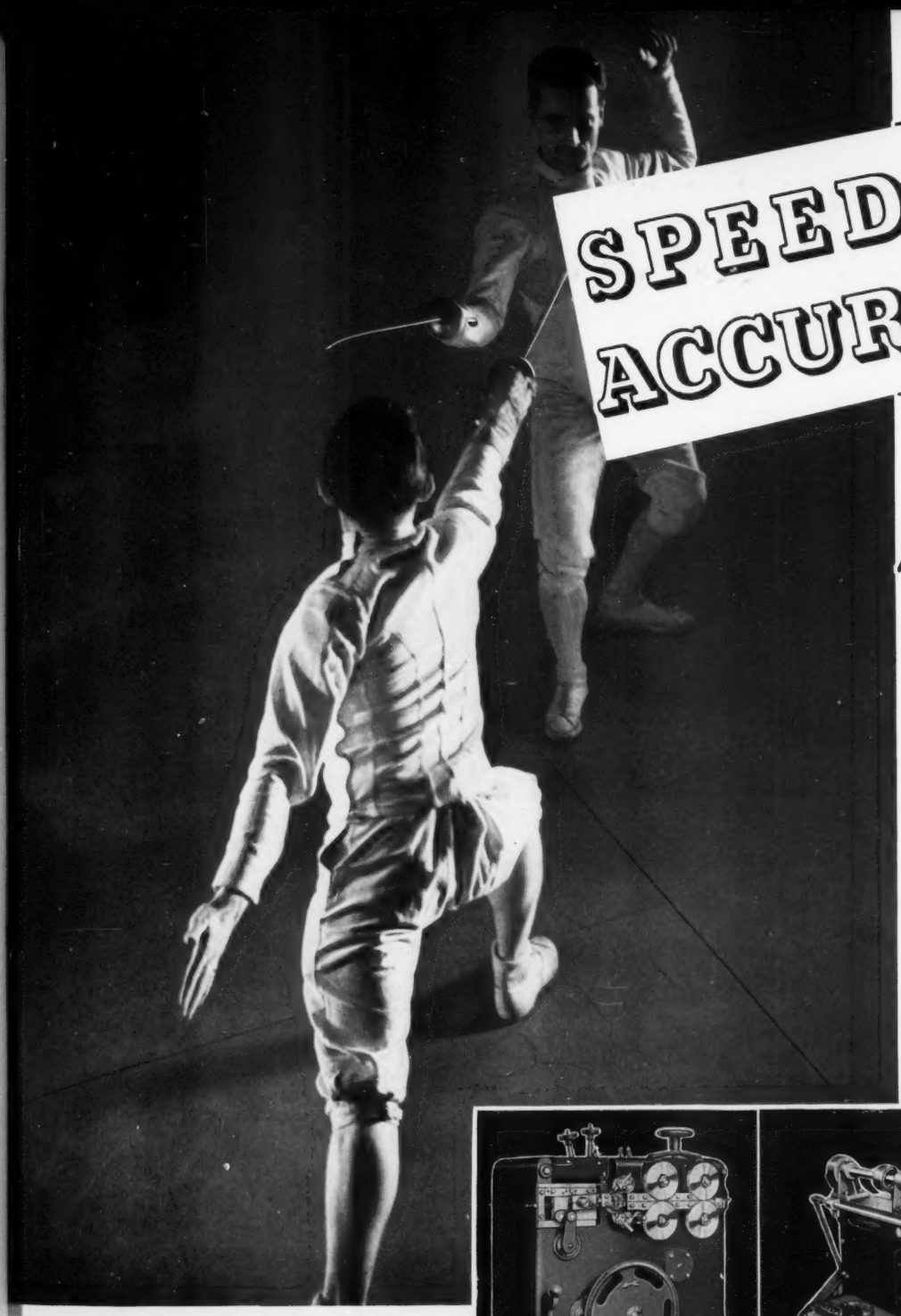
FINISHING DIE HOLDER: Universal adjustment for casting wire; provision for clamping die against movement.

STRINGERS: Hand or power driven.

WATERBURY FARREL FOUNDRY AND MACHINE CO.

WATERBURY, CONNECTICUT, U. S. A.

CLEVELAND CHICAGO NEWARK, N. J.

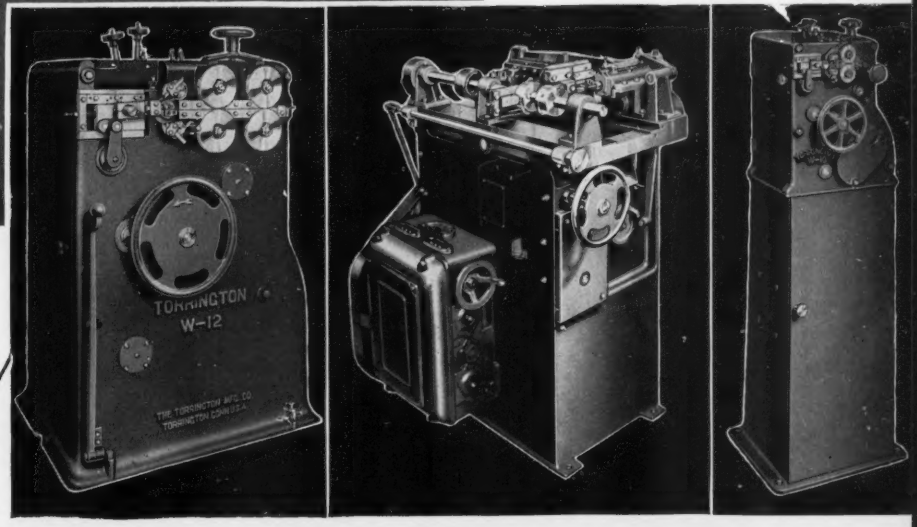


SPEED and ACCURACY

Spring makers using Torrington Spring Coiling and Winding Machines are reducing manufacturing costs—are making real savings — are adding to profits by producing substantially more coil springs per machine hour — are satisfying customers with springs made to new standards of accuracy and uniformity.

You, too, can benefit by the exclusive patented features of design inherent in all Torrington Spring Coiling and Winding machines and discover why, since their introduction, more Torrington Spring Coiling and Winding Machines have been sold than all other makes combined.

Send for bulletins giving details of a complete range of sizes of Segment and Clutch Type Coilers, and Torsion Spring Winders. We will quote guaranteed production figures for samples of springs submitted.



Shown at the right are two sizes of Torrington Segment and Clutch Type Coilers and (center) a Torrington Torsion Spring Winder.

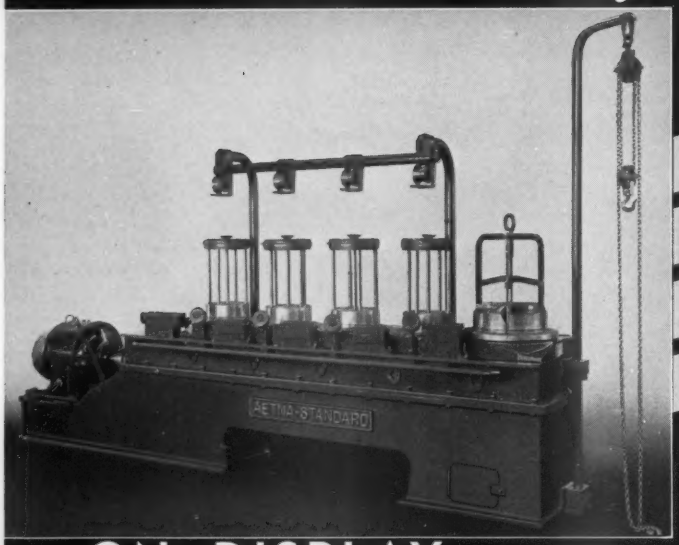
The Torrington Manufacturing Co. is associated with W. H. A. Robertson & Co., Ltd., of Bedford, England.

Spring Machines by

TORRINGTON

THE TORRINGTON MANUFACTURING CO.
TORRINGTON, CONNECTICUT • • • • U.S.A.

AETNA-STANDARD
Wire Drawing Machines

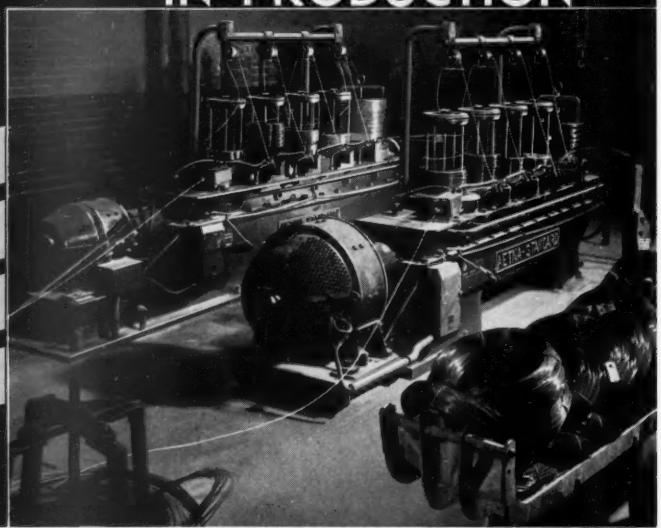


. . . Trimly Designed
Ruggedly Constructed
Amply Powered . . .
. . . . Space Saving.

ON DISPLAY

ARE "Good News" IN PRODUCTION

Better Wire Quality
At Higher Drawing Speeds
By Thoro Water Cooling
Both Blocks and Dies.



THE AETNA-STANDARD ENGINEERING COMPANY

CONSULTANTS—DESIGNERS AND BUILDERS TO THE STEEL AND NON-FERROUS INDUSTRIES

Home Office . . . YOUNGSTOWN, OHIO, U. S. A.

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Head, Wrightson & Co. Limited, Thornaby-on-Tees, England. Aktiebolaget Arboga Mekaniska Verkstad, Arboga, Sweden.

WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. 14 FEBRUARY, 1939 No. 2

Designated as

Official Publication By The Wire Association

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—ASSOCIATE EDITORS—

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Lancaster, Allwine & Rommel, Consultants on Patent Information
European Correspondent
Paul Fidrmuc

Richard E. Brown, General Manager
R. S. Spengel, Business Manager
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Publication Office: Washington, N. J.
Executive Office: 17 E. 42nd St., New York, N. Y.
Annual Subscription, U. S. $5.00, Canada $5.00

50 Cents a Copy Issued Monthly Foreign, $7.50

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WIRE & WIRE PRODUCTS, Vol. 14, No. 2, February, 1939, Executive office, 17 East 42nd St., New York, N. Y. Published by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S. Spengel, Secretary and Treasurer. Publication office, 13 West Church Street, Washington, N. J. Subscription price: U. S., $5.00; Canada, $5.00 per year, 50 cents per copy; Foreign, $7.50 per year. Entered as second class mail at the Post Office, Washington, N. J., under Act of March, 1879.

GOING TO PRESS

March 1st, 1939

THE 1939 EDITION

of the

WIRE & Wire Products'

-Buyers Guide- and Year Book

of the

WIRE ASSOCIATION

The only reference book available listing all components of the wire industry, completely indexed.

Invaluable to purchasers of rod, strip, bare and covered wire and cable, cold drawn bars and cold headed products.

Gives sources of machinery, materials and equipment for manufacturers of rod, strip, wire and wire products.

✦ ✦ ✦

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17 East 42nd Street New York, N. Y.

Official Publication of the Wire Association

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WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.

DRAWING --- ROLLING--- EXTRUDING --- FORMING --- FABRICATING

Vol. 14 FEBRUARY, 1939 No. 2

Some Aspects of the Patenting Process

By G. K. Rylands,
General Manager,
Rylands Brothers, Limited, Warrington, England.

A study of patenting and the bearing of grain size on the quality of the patented microstructure. The author states that it is now possible to meet without trouble, specifications which formerly gave rise to bulk rejections. ✦ ✦ ✦ ✦

IT was in Warrington that the Patenting Process was first developed, and in a recent issue of "Wire and Wire Products" Mr. Kenneth B. Lewis gave some interesting historical information about it. Today we take patenting more or less as a matter of course, but when it was first developed by **Horsfall**, it was without doubt, one of the most revolutionary inventions in the Wire Trade.

✦ ✦ ✦

PRIOR to its introduction, it had been quite impossible to draw steel of a carbon content very much higher than 0.25% and obtain satisfactory results, and in those days wire of high tensile strengths such as is now used for ropes was quite unknown. It may be said, therefore, that the development of the Patenting Process was largely responsible for the development and growth of the Wire Rope Industry.

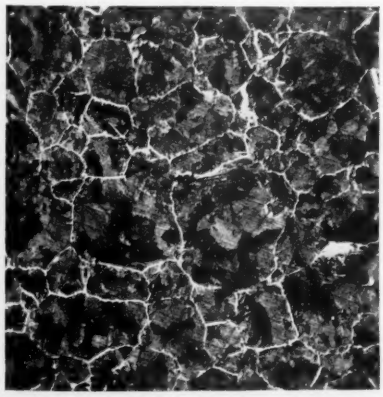

Fig. 1. 5 S. W. G. Air Patented. C. 0.56%, Mn. 0.70%. X100. ✦ ✦ ✦

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IT is not known how **Horsfall** got the idea of Patenting, but it is fairly certain that his process was not based on any specific knowledge of steel micro-structures. In those days, no wire works in England would have dreamt of establishing a Laboratory, or investigating the processes connected with Wire Production. As a consequence, many strange superstitions grew up around the patenting process, and in practically every works in which it was practiced, the utmost secrecy was preserved.

IN the early days, the process in effect amounted to nothing more than a high temperature normalizing, which produced a coarse grain in the patented rod and allowed a greater degree of cold work to be performed before the wire became over-drawn. The microstructures consisted of a mixture of coarse and fine pearlite surrounded by envelopes of free ferrite. A typical example is illustrated in Figures 1 and 2. Such material could be given a reduction of area up to 75/80%, and the wire produced would stand good torsions. If a greater re-

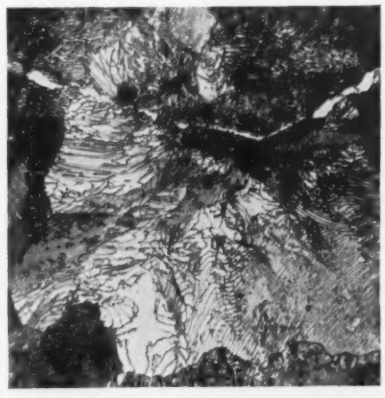

Fig. 2. Same as Fig. 1. Showing Sub Grains of Pearlite. X1000. ✦ ✦ ✦

Designated as Official Publication by the Wire Association

duction of area were imposed, the torsions were generally maintained, but the wire was relatively brittle on "snarl" and almost invariably broke with a long tongue. Bend tests were usually poor compared to those obtained on patented material today.

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IN the old furnaces, temperature control was entirely absent, and there were very few furnaces fitted even with pyrometers until well on in the present century; in fact, it is probably true to say that no material technical development was made until after the Great War. The whole control of the process was therefore in the hands of the foreman in the Patenting Shop, and the solution of most troubles was to get the furnace hotter, or if this failed, to run the wire slower. Patent House Foremen were credited with the possession of many secrets which generally died with them, but the quality of the scale was always regarded as a sure indication of the quality of patenting. If the scale shelled off the rod in large semi-circular flakes, the patenting temperature was considered satisfactory. The reason for this was probably two-fold, in so far as scale of this character is only produced at the high temperatures which were necessary to obtain the required enlargement of grain, and also because heavy scaling undoubtedly removed many shallow surface defects from which hot rolled rods of that day inevitably suffered.

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IT was also implicitly believed that twice patented wire was better than wire drawn direct from a patented rod. It is probable that this was true, but only because two heavy scalings removed even rather deep-seated surface defects. This is not surprising when it is borne in mind that two patentings and cleanings would remove anything up to 5% of the original weight of the rod. Naturally, wire treated in this way was deeply decarburised, but since there were no microscopes to show up this condition, nobody worried, and in any case a rod with

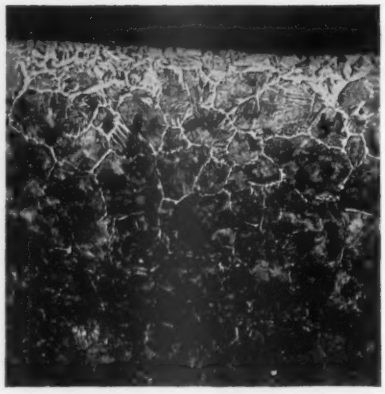

Fig. 3. Decarburized Surface of Air Patented Rod. X100.

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a decarburised skin was easier to draw. Photomicrograph Figure 3 shows the decarburised skin on an air patented rod from one of the old type Patenting Furnaces.

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MANY of the old superstitions still exist, although the reasons for them have long since died.

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CURIOUSLY enough, it was not many years after the Patenting Process was first discovered that the benefit of accelerated cooling was noted. It is possible that the fact was observed that wire patented in a fine size, which cooled quickly, was generally superior to that patented in a heavy gauge rod which cooled slowly, but however, it came to pass, the **Sand Patenting Process** was invented in Warrington by one **Ratcliffe.** In the latest development of this process, the wires left a tubular furnace and plunged into a bed of sand travelling on a slat conveyor in the opposite direction to the travel of the wire. The sand was fed on to the slat conveyor through a chute, the position of which could be altered so that any desired length of bed could be obtained. The sand fell over the end of the slat conveyor into a sump, from which it was picked up by a bucket conveyor and tipped into the chute. This process was installed in our own Works towards the beginning of the present century, and there is no doubt it gave very improved results. At the time of its installation it was immensely secret, and the whole plant was walled round and carefully locked during the week-ends. No-one except the foreman in charge and possibly the General Manager were ever allowed to enter. An exception was however made in the case of the foreman of the Engineering Department, who was exclusively in charge of the maintenance of the apparatus.

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THIS process, again, was developed by a man with no metallurgical knowledge and entirely uninterested in the microstructures of steels. He had merely found by experience that accelerated cooling gave improved results, and accelerated cooling was therefore adopted without any undue curiosity as to the whys and wherefores.

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FIGURES 4, 5, and 6 show the comparative micro-structures of rods of identical carbon and manganese contents, as rolled, air patented, and sand patented on one of our old furnaces. It will be observed that the sand patented micro-structure compares very favourably with the best microstructures obtained today. There is almost a complete absence of pearlite, as shown by photomicrograph figure 7 at a higher power, and very nearly complete absorption of ferrite.

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THIS process was practiced with success in our works until about 1930, and as a method of accelerated cooling has much to recommend it even today. The furnace to which the apparatus was attached, was, however, of a very old type and any accurate temperature control was quite impossible. Although pyrometers were fitted to the furnace, these did not necessarily give the temperature of the wire, but merely that of the brickwork at some point in the furnace. The optical pyrometer was however used with some success, but it was found extremely difficult to instruct the charge-hand in the use of this instrument.

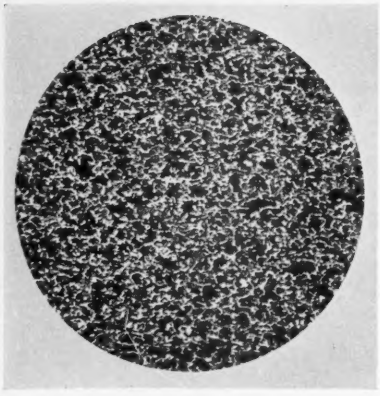

Fig. 4. Hot Rolled Rod. C. 0.57%, Mn. 0.72%. X100. ✦ ✦ ✦ ✦

Fig. 5. Satisfactory Air Patenting from Rod Shown in Fig. 4. X100. ✦ ✦

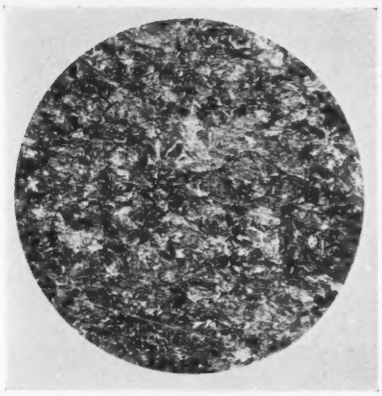

Fig. 6. Patenting Similar to Fig. 5 But Cooled in Sand. X100. ✦ ✦ ✦

IMPORTANCE has always been attached to the grain size of patented micro-structures, but apparently neither the optimum grain size nor any basis on which the count is to be made has ever been defined. In general, it has been the practice to define the grains by the boundaries of free ferrite. So far therefore, as grain size is concerned, the micro-structure illustrated in Figure 1 would be considered satisfactory for air patenting. The grains, themselves, however, consist almost entirely of sub-grains consisting of coarse and fine pearlite as shown in Figure 2. Wire drawn from this base might yield satisfactory torsions, but its other physical properties would be poor and its fatigue and endurance properties would be low. This wire was in fact produced on an old type of furnace with a sand seal at its exit end, intended to restrict scaling. The wire left the sand seal, generally below the critical point, so that any patenting effect was negligible, and the treatment amounted to no more than a high temperature normalizing, similar to that on the very earliest furnaces in use.

✦ ✦ ✦

FIGURE 8 shows an unsatisfactory air patented micro-structure. In this case, the carbon content of the steel is slightly lower than that illustrated in Figure 1. The grain size is however, very much smaller, ferrite absorption has been negligible, and the general micro-structure is ferrite/pearlite. This type of micro-structure is very similar to that of the "green rod", although the grain size is slightly coarser.

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IN Figure 9, as defined by the ferrite envelopes, the grain size would be deemed large. In this case, however, the micro-structure is quite different from that shown in Figure 1, since the grains themselves consist almost entirely of sorbite with perhaps traces of fine pearlite. On the basis therefore, of grain size alone, as defined by ferrite envelopes, this micro-structure would be considered satisfactory and there is no doubt that wire drawn from it would possess admirable physical properties, and indeed very much better than those drawn from the micro-structure shown in Figure 1. In the case of Figure 9, however, it will be noted that the ferrite envelopes are very fine and that ferrite absorption has been good, whereas in the micro-structure shown in Figure 1 the ferrite envelopes are coarse and the ferrite absorption has been small. If in the case of Figure 9 the ferrite absorption has been complete, the ferrite envelopes would have vanished and the micro-structure would have been as shown in Figure 10. This is still an excellent patented micro-structure, but

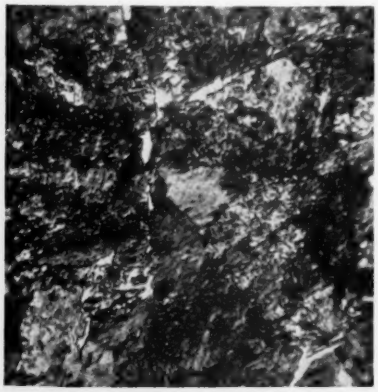

Fig. 7. Sorbitic Pearlite in Fig. 6. X1500. ✦

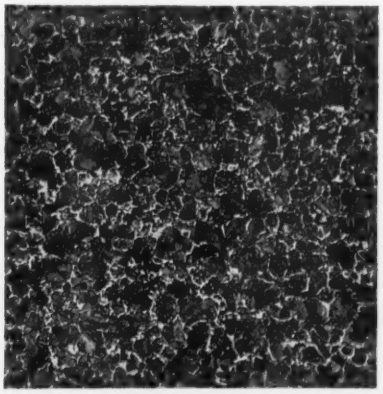

Fig. 8. Unsatisfactory Air Patented Rod. Poor Pearlite Absorption and Small Grains of Fine Pearlite. C. 0.45%, Mn. 0.73%. X100. ✦

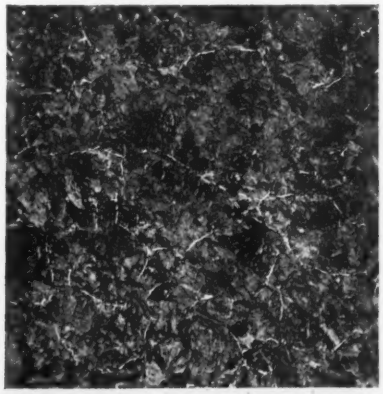

Fig. 9. Large Grains of Sorbitic Pearlite. 5 S. W. G. Air Cooled. C. 0.59%, Mn. 0.62%. X100.

since there are no ferrite boundaries to define the grain size, its definition becomes a matter of some difficulty. Casual observation would suggest that the grain size is too small. In actual fact, Figures 9 and 10 are taken from the front and back ends of the same coil of rod, patenting conditions being identical except for the rate of cooling. The micro-structure of Figure 10 consists entirely of sub-grains of sorbitic pearlite, these grains being no smaller than the ferrite enclosed grains shown in the relatively poor micro-structure illustrated in Figure 1. This apparent change in grain size was not reflected in the physical tests which were identical at both ends of the fnished wire.

✦ ✦ ✦

IT is clear therefore, that grain size as usually interpreted has very little bearing on the quality of the patented micro-structure. If ferrite boundaries are present it is the micro-structure within the boundary that is of importance and not necessarily the size of the area enclosed. There is generally a reason for most superstitions, though many of them are lost in the mists of antiquity. In this case however, the reason is fairly clear. For example, observation had shown that good results were obtained from micro-structures showing attenuated ferrite boundaries surrounding large areas. In such cases the ferrite absorption is good and it almost necessarily follows that the formation of pearlite would be suppressed. As a consequence, it was concluded that any micro-structure in which large areas were enclosed by ferrite boundaries must be good. The absurdity of this conclusion is obvious when one considers that its acceptance without reservation would entail the acceptance of over-heated and slowly-cooled micro-structures as good micro-structures.

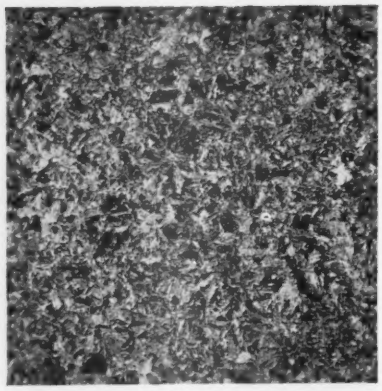

Fig. 10. Similar to Fig. 9 But Cooled Through Sand. Sub Grains of Sorbite. No Ferrite Grains. X100. ✦ ✦ ✦ ✦

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IT is clear therefore, that the nature of the micro-structure is of paramount importance. It should show an entire absence of pearlite. Small quantities of free ferrite are generally unavoidable in low carbon material, but provided the quantity is small and pearlite is absent, the physical properties of the wire are not materially impaired. The exact importance of the grain size is difficult to define, and it is still more difficult to control under even modern conditions of patenting. It depends not only on the patenting temperature, but also on the amount of cold work to which the wire may have been subjected before patenting.

✦ ✦ ✦

IT is also true that different steels subjected to precisely the same patenting conditions will exhibit different grain sizes. Within however, the normal limits of variation found in material produced in a well controlled lead patenting furnace, variations in grain size do not appear materially to affect the usual ductility tests of the wire produced. So far as wearing and fatigue properties are concerned, there may be an optimum grain size, but this has yet to be determined. It seems clear however, that the optimum grain size for any job must depend to a large extent on the degree of cold work to which the wire will be subjected in reducing from the patented base size to the finished wire, and on the purpose for which the wire is to be used. It is obvious that the size of the grains in a 5 S. W. G. patented rod must be larger than those in the same steel re-patented in say 14 S. W. G. But the question is How much larger? It is surely not unreasonable to assume that the total number of grains across the diameter should be constant irrespective of the size of the wire or rod.

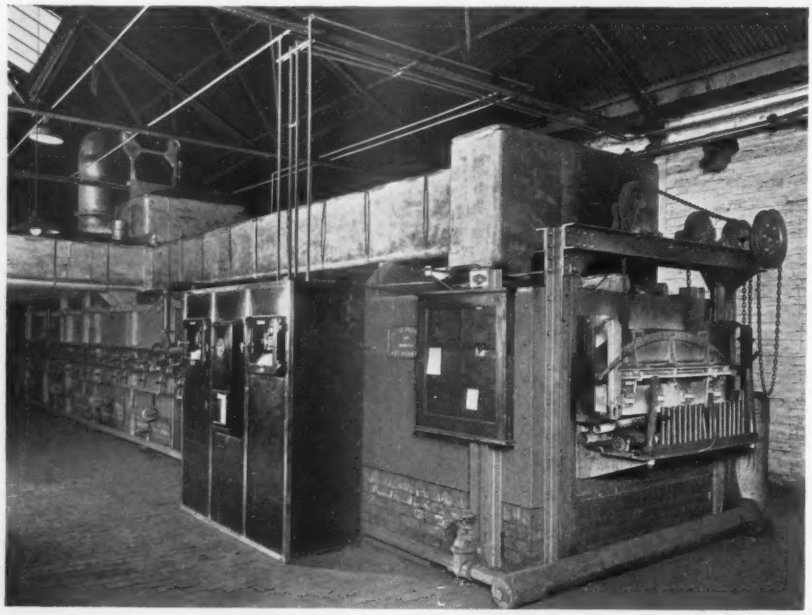
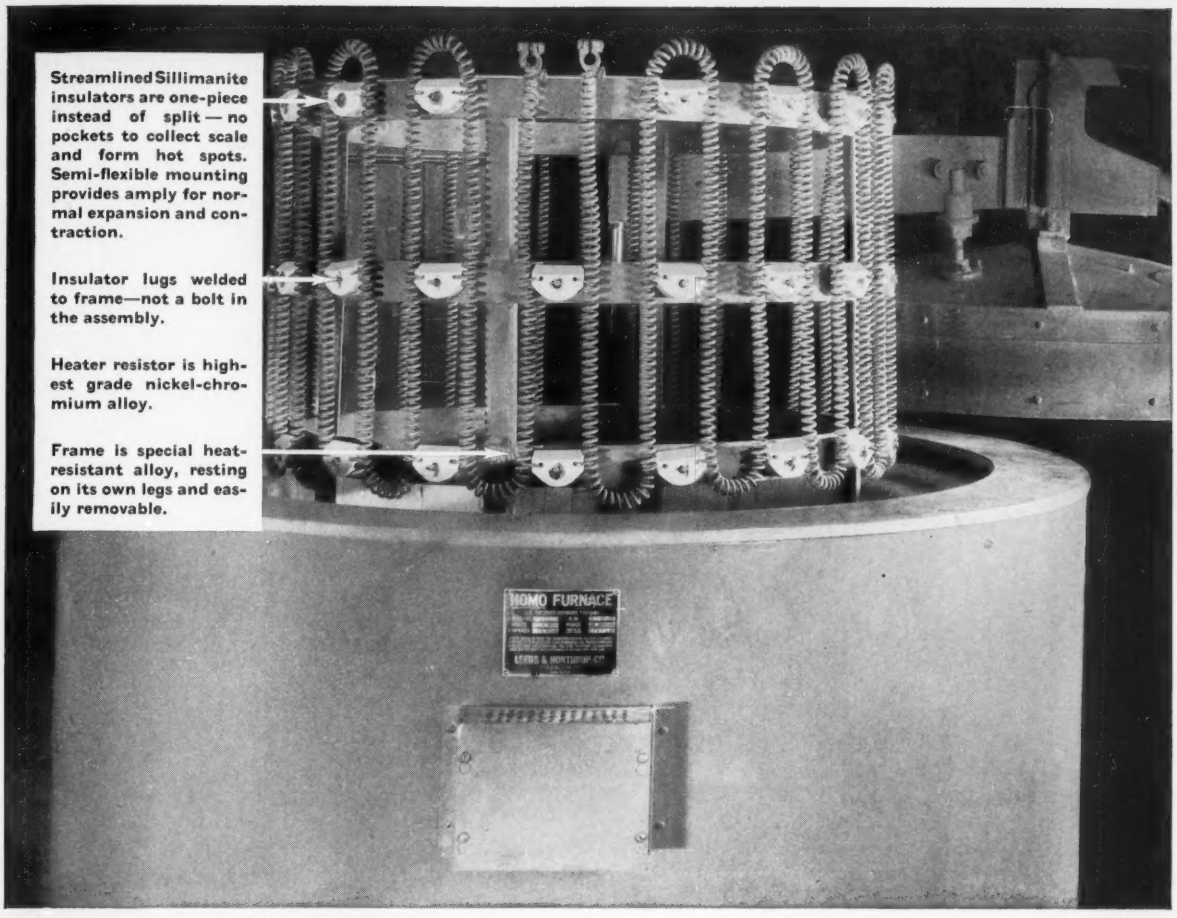


Fig. 11. General view of furnace. The cabinet near the entrance end contains a Leeds & Northrup 2 point temperature recorder with automatic control equipment and also an autographic gas flow recorder. ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

(*Please turn to Page 130*)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J-T625(10)

Reactive Wire Drawing

By H. A. Stringfellow
New York, N. Y.

This description of "Reactive Wire Drawing" appears to cover the first patent which has been issued on this specific section of the art of wire drawing in this country. The patent office requested the applicant for the patent to bring it to issue in order that it might be used as a citation against five other inventors who appear to be locked up tightly in an interference. The issuance of this patent should serve to clarify this situation. ✦ ✦ ✦ ✦ ✦ ✦

THE practical value and potentialities of a back-pull, tension or retarding strain on wire during passage through a die has been admitted by wire drawers ever since the first experiments along these lines were made in England and Scotland. Especially was back-pull valuable in drawing the finer gages of alloy and specification steels.

✦ ✦ ✦

DURING this experimental period, the back-pull or tension on the wire passing through the die was obtained by stakes, brakes, weights, and snubbers which were utilized without unqualified success. Practical difficulties were encountered. Variations in the physical characteristics of rods and wire in different coils, or even within the same coil, made the application of a uniform stress impractical and even detrimental. Hence the application of back-pull methods to commercial wire drawing has been, until now, thwarted by practical difficulties and have not found a general or trouble-free use.

✦ ✦ ✦

THE **Smith-Stringfellow** Reactive Wire Drawing Block, on which Patent No. 2,138,126 was granted in November, claims to do away with the hit-or-miss application of back-pull tension and to automatically apply, at all times during each and any draft, a proper amount of back-tension to suit the elastic limits of the wire and at the same time to apply this tension with maximum efficiency.

✦ ✦ ✦

IF a device is employed which is set to apply a fixed drag on the wire moving to the die, it is obvious that the drag so exerted must be maintained at a value below that which would affect the lowest substantial reduction in die pressure (which is the primary object in using back-pull) but, for maximum efficiency, the back-pull applied should be reasonably close to the elastic limit of the unreduced wire. With a fixed retarding device applying a constant back-pull, it would not be feasible to attempt to apply a back-pull close to the elastic limit, because in order to do so, it would be necessary to first determine the lowest tensile strength of each coil of wire and then adjust the back-pull accordingly. This, however, would not allow for the specific variations in quality of the wire throughout the coil.

✦ ✦ ✦

IN the method under discussion, instead of maintaining a definite back-pull on the material being drawn, there is maintained instead a fixed ratio, less than unity, between the back and forward pulls. By so doing, a definite proportion of the load is imposed on the die at all times and, therefore, the danger of the wire being stressed beyond its elastic limit, with consequent breakage, is reduced to a minimum.

ACCORDING to the Reactive method the load imposed on the die automatically determines the amount of the back tension. The die is always forced to supply a fixed percentage of the drag, and the back tension is kept safely below the elastic limit of the wire.

✦ ✦ ✦

THERE is no direct adjustment of the back tension. There is a built-in adjustment of the ratio between the pulls in front of and behind the die. The tensile strength of the wire in one coil might be five times that of the wire in the next coil, yet both coils of wire can be passed through the die with a back tension near the elastic limit of the wire in each case without changing the adjustment of the machine.

✦ ✦ ✦

IN passing a given coil of wire through the die, and variations in load upon the die, due to the variations in the physical characteristics along the length of the wire, are substantially proportional to the variations in normal load imposed on the die; since the load on the die is at all times substantially a fixed fraction of the normal load without back tension. These variations, however, are much less in amount because the initial load on the die is greatly reduced by the back tension in the wire. Also, the variations in the tension in the wire between the die and the pulling block due to variations in the drag of the die are correspondingly less.

✦ ✦ ✦

PROF. F. C. THOMPSON of Victoria University, Manchester, (WIRE & WIRE PRO-

DUCTS, December, 1933, Page 400), demonstrates that the reduction of the load on the die due to a back tension on the wire is directly proportional to the amount of back tension applied, and approaches zero as the back tension approaches the elastic limit of the wire. By maintaining a fixed ratio, less than unity, between the forward and back tensions, the drag necessary to balance the forward tension must always be supplied by the die and the retarding device is prevented from exerting a pull sufficient to take the load off the die. Thus a back tension may be maintained which is close to, but always less than, the tensile strength of the wire regardless of what the actual tensile strength of the wire may be.

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THIS method, although decidedly applicable to continuous drawing, is essentially a single-hole process in principle; each hole is a unit in itself composed of hold-back block, die and draw block, no matter how these parts may be mechanically arranged, and the superior results obtained reside entirely in the interaction of these three essential parts.

✦ ✦ ✦

FOR continuous work as many units as may be required can be constructed in tandem and synchronized in speed by any one of several satisfactory methods. Each die, however, remains an independent single-hole machine and could be operated as such.

✦ ✦ ✦

AS previously mentioned, the primary object in the use of back tension is to substantially reduce the die pressure. This reduction in pressure varies directly with the amount of back tension applied, but it does not vary at a uniform rate. Experiments have shown that there is probably an optimum value for the amount of back tension to be applied for any set of conditions of drawing (reduction, material, and speed). Further and more detailed experimentation is required to determine this precisely and to harmonize the results obtained.

CONDITIONS have been encountered in experimental work in which the forward pull required to draw with back tension is less than that required to draw in the conventional manner, through a certain range of reductions (all other conditions remaining unchanged); when the reduction falls outside of this range, either above or below, the forward pull increases when back tension is applied. This may account for the various conflicting claims and statements made in regard to a saving in power secured by the use of back tension.

✦ ✦ ✦

IN the Reactive Method of drawing, power saving, per se, is not a primary object; but as this method is entirely automatic in operation and when once set for optimum conditions of drawing will maintain those conditions, any saving in power which may reside in the use of back tension is realized to the greatest extent.

✦ ✦ ✦

IT is the opinion of the inventors, however, that the securing of maximum die life and, therefore, minimum cost, maximum production and a more uniform and superior product with no increase in unit cost, and probably reduced unit cost, is more to be desired than any problematical absolute saving in power cost, especially so as power is usually one of the smallest items in the cost of drawing wire.

✦ ✦ ✦

WIRE drawn by this method, it is claimed, shows a marked improvement in physical qualities, especially in regard to uniformity in hardness. Hardness being a function of the amount of cold work performed, and tensile strength being also a function of the amount of cold work, it follows that hardness is also a measure of the tensile strength. Hardness, or more correctly, uniformity in hardness, is also a measure of the strength in torsion and torsion is a function of the fatigue resistance of the metal. It is, therefore, evident that uniformity in hardness is of primary importance in a superior wire because it is a measure of other desirable physical characteristics.

✦ ✦ ✦

WIRE drawn by conventional methods is not uniform in hardness throughout its cross section. The hardness at the center is greater than the hardness at the surface, an increase of from ten to fifteen per cent being not uncommon.

✦ ✦ ✦

WIRE drawn by the Reactive Method, through a properly proportioned die and with the proper amount of back tension, can be made uniform in hardness from surface to center. As regards the effect on the die itself, the heavy wear experienced in the cone at the point of impact, commonly known as ringing, is greatly reduced, as is also the wear on all portions of the die cone. The land of the die shows very little wear and, therefore, roundness and gage are maintained for a much greater time in service.

✦ ✦ ✦

THE Reactive Method of drawing makes it possible to use back tension in commercial drawing and to obtain very closely in production the laboratory advantages of back-pull drawing, which have been demonstrated by various investigators.

✦ ✦ ✦

Summary

THE Reactive Method of Wire Drawing:

1. Makes possible the commercial use of back tension.

2. Applies the optimum amount of back tension to each increment of wire passing through the die.

3. Applies back tension with maximum efficiency.

4. Operates with the lowest possible die pressure.

5. Requires no special technical knowledge to operate.

6. Produces a superior wire in respect to the qualities of uniformity in hardness, torsion, and fatigue resistance.

7. Makes possible the production of high carbon, stainless, alloy, and specification steel wires of superior quality and at lower cost.

Wire for Steel Cables

A short description of the manufacturing processes of E. H. Edwards Company of San Francisco, California, featuring the use of natural gas fuel.

WIRE is cold-drawn in successive steps through a series of dies to reduce it from large to smaller diameters by easy stages. The dies are blocks of specially hardened steel with apertures large enough on the receiving side to take the wire coming in, the aperture diminishing funnel-shape to the discharge outlet whose opening is of the exact size of the wire wanted at that particular stage of the work. The dies necessarily must be kept true to gauge by minutely correct dressing with foolproof precision tools.

✦ ✦ ✦

ONE mile of wire drawn down from 16 gauge to 17 gauge will weigh the same before and after. While the diameter has been reduced 24 per cent, the original mile of 5280 feet is stretched 26 per cent to 6552 feet; 1372 additional feet have thus been squeezed out back of the die through lengthening the grain of the steel, the carbon content of which has a great deal to do with this phenomenon. For it is that when, for example, one mile of quarter inch wire passed through numerous successive dies emerges sized say for the finest wire cloth without change in gross weight, though miles longer.

✦ ✦ ✦

DRAWING wire from one large spool or reel through a die to another spool is so rapid that one can actually hear things hum. The scientific theory of what happens of course tells the story and is accepted as the explanation of why the steel does not bunch up on the inlet side of the die funnel. Inches are stretched into feet and the finished product is a perfect strand of flexible steel wire of any predetermined diameter and quality.

✦ ✦ ✦

OCCUPYING the better part of nine acres, with shops and the last word in wire treating and drawing equipment, consuming monthly from three to three and one-half million cubic feet of natural gas from the lines of the Pacific Gas and Electric Company, the E. H. Edwards Company has been in operation in South San Francisco since 1917. Building up from small beginnings and always with an eye to quality, this company today is in the front rank on the Pacific Coast with wire rope, stucco mesh, welding rod, fish trap netting, and many similar products.

✦ ✦ ✦

BUNDLED coils of wire rod, the raw material for wire drawing operations, are received from outside steel mills. The treatment applied to this rod stock makes it ready for a wide variety of uses. Heat in enormous quantities is the major factor in fashioning wire for any purpose, be it the humble commodity sold by the yard over the hardware counter, the mesh destined to be buried in plaster in the walls of buildings, or stout cable capable of lifting many tons with derricks and power shovels, or operating elevators safely.

✦ ✦ ✦

IN the last two categories the requirements and specifications are extremely exacting. Tensile strength and flexibility must go together dependably, hence the manufacturing processes are scientifically and mechanically precise, applying true craftsmanship in the time honored conception to today's mass production principles.

✦ ✦ ✦

GEORGE E. McDONALD, general superintendent of E. H. Edwards Company, has been "through the mill" and every operation in this large South San Francisco plant carries the imprint of his management. Nothing is left to chance or guesswork. Complicated floor lay-outs of thousands of square feet for treating, annealing, tempering, drawing, stranding and testing are easily followed in the progress of the work. Everything is in its place and orderly, there is no confusion of men or material, efficiency is obvious throughout and cleanliness prevails, with natural gas employed exclusively for the generation of all heat required.

✦ ✦ ✦

THE coils of raw material rod are first dipped in acid pickling for removal of scale, after which they are immersed in a lime vat to neutralize the acid. They are then put through a heated oven to bake on the lime and remove excess water. This wire baking unit is equipped with two high pressure tile burners automatically controlled at approximately 350 degrees F.

✦ ✦ ✦

THE next step is to run the wire through an "air patenting" furnace with 40 funnel type burners manifolded to high pressure automatic proportioning inspirat-

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ors, 20 on each side. This baking furnace is 40 feet long, the wire being run through and wound up on reels, the heat treatment varying according to the purpose for which the wire is intended. The effective firing area is one foot by three feet and uses about 1850 degrees, suiting the annealing specifications in any given case.

✦ ✦ ✦

A "lead patenting" furnace in effect gives the wire a lead bath. Three heat zones respectively preheat, heat-soak and lead quench the strands as they travel through at a high rate of speed from one reel to another, taking this fiery bath en route. This toughens the product by tempering and when required wire is returned time and again for additional treatment to bring it back to standard after a series of drawings to smaller sizes have taken place.

✦ ✦ ✦

THE "hot lead pan," or high heat zone, is fired with four Surface Combustion Corporation two stage velocity burners. Installations of that make are found throughout the plant. This closed type patenting furnace operates at a gas pressure of 22 pounds and consumes 2000 cu. ft. per hour, production being approximately 37,000 pounds of wire in 24 hours.

✦ ✦ ✦

HAVING passed this stage, the wire is on its way to the "cold lead" pan, where it is quenched in a lead bath of lower temperature. The inside dimensions of this oven are 24 feet by 38 inches by one foot high, outside 26 feet by six and one-half feet by three feet high. Gas consumption per hour is 1900 cu. ft., burner pressure 16 pounds.

✦ ✦ ✦

IN these operations the burners are set at a point where according to experience proper results are obtained. Numerous individual strands of wire are run through parallel to one another at fixed rates of transit. With that speed closely maintained in relation to the temperature applied the wire will meet the set specifications. Close observation by the operators is important and they realize that if speed is lost the heat application likewise will go wrong. Gas has been found so steady and dependable that its prime importance in this part of the work can virtually be forgotten so long as the attendants keep the wires running fast enough.

✦ ✦ ✦

INCIDENTALLY, heat is maintained during plant interruptions because it has been established that this procedure lengthens the life of the equipment, a matter of economy in the long run, practiced economically with gas.

✦ ✦ ✦

ONE annealing furnace of the "air patenting" type functions at 1100 degrees with tunnel type burners and high pressure inspirators. What galvanizing is done is by standard methods, the kettles being fired with impact type burners and high pressure automatic proportioning inspirators.

✦ ✦ ✦

THE record here as elsewhere is that natural gas offers the definite advantage of prolonging the life of the galvanizing pots. Mr. McDonald says that that is his experience since natural gas was connected in the Edwards plant.

✦ ✦ ✦

AN outdoor annealing tower receives the wire in coils. Sealed to exclude the air, it operates at from 1230 to 1300 degrees, with seven two stage velocity type burners. There are two cooling pits here and the product is low carbon, "dead soft" wire such as for baling and similar purposes where a pliable material of ordinary strength is required.

✦ ✦ ✦

THE highest grade wire for heavy duty lifting and elevator service goes through many drawing and re-tempering steps. Before the reels are placed for braiding, where single wires by the dozen are woven into the finished article, repeated tests are made in a special department of this modern "rope plant" to make sure that every piece is up to the required tensile strength and torsion capacity.

✦ ✦ ✦

AN immense floor space is occupied by a whole series of stranding machines in which single wires are fed from spools and braided automatically into staunch steel cable. The "lay" or twist of the strands and the finished rope are built up here as they come together at just the proper point and at the precise speed required from one end to the other of these long-sprawling assemblies of guide frames and feeder pulleys. The product is steel cable of exact diameter and known capacity.

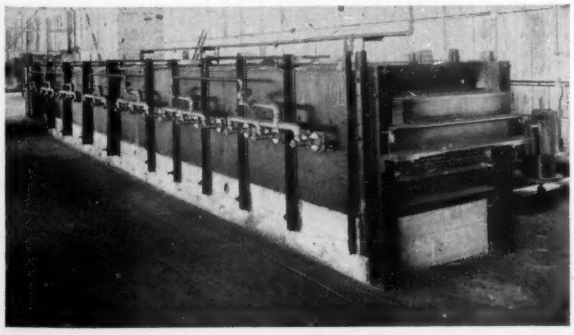


Fig. 1. An air patenting or wire treating furnace with 40 funnel type burners. ✦ ✦ ✦ ✦ ✦ ✦ ✦

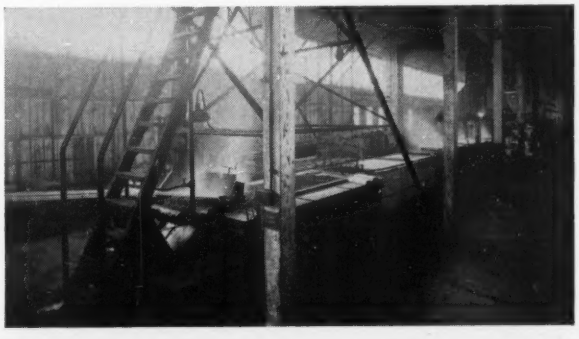
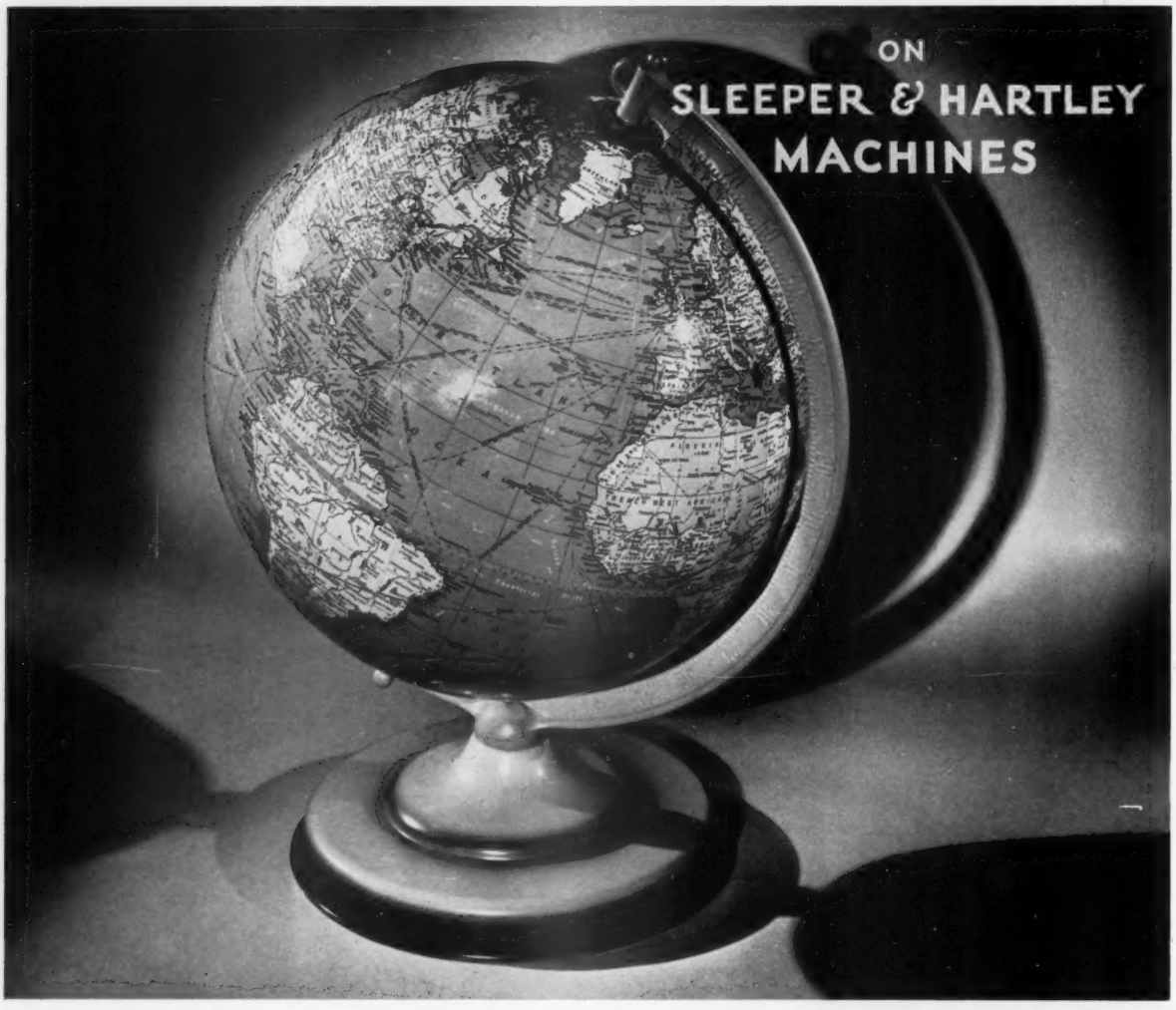


Fig. 2. Gas fired wire galvanizing unit. ✦ ✦ ✦

"THE MACHINES THAT PUT THE 'RINGS' IN SPRINGS"

THE SUN NEVER SETS



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Vol. 14 FEBRUARY, 1939 No. 2

Analysis of Effect of Wire Curvature on Allowable Stresses in Helical Springs

By A. M. Wahl,

Research Engineer,

Westinghouse Research Laboratories, East Pittsburgh, Pa.

The author suggests a method for determining the effect of wire or bar curvature on allowable stresses in helical springs, based on the endurance properties of the material. The method is based on the assumption, in agreement with available fatigue-test data, that stress-concentration effects produced by wire curvature may be neglected in calculating the static component of applied stress; also, it is assumed that the relation between the static- and variable-stress components at failure follows a linear law. On this basis, charts are given for determining maximum allowable stress as a function of spring index, ratio of minimum to maximum stress, and ratio between yield point and endurance limit. The effect of sensitivity of the material to stress concentration is taken into account by introducing a sensitivity-index q. Results calculated by means of the equations given show good agreement with results from tests of springs of different indexes. Some of the limitations of the method are discussed, and suggestions are made for future testing work. ✦ ✦ ✦

AN article[2] published in 1929 gave the results of strain measurements on helical springs, and indicated that the maximum stress in such springs may be much higher than that figured by using the conventional helical-spring formula. The difference is particularly pronounced for springs having small indexes, i.e., low ratios of coil diameter to wire diameter. This stress increase may be accounted for by (1) direct shear due to the axial load and (2) stress-concentration effects due to wire or bar curvature. On the basis of the strain measurements, reported in the 1929 paper,[2] an approximate formula was developed for calculating the maximum stress in such springs. The application of this formula involves the multiplication of the conventional formula for helical springs by a factor K which depends on the spring index. The results as computed by this theory were in close agreement for practical springs with an approximate formula given by **Röver**[3] in 1913, and also with a more exact formula developed later by **Göhner** who applied the theory of elasticity to the problem.[4]

✦ ✦ ✦

WHILE it may be said that the problem of calculating the maximum stress in helical springs as affected by wire curvature has been solved[5] (assuming elastic conditions) the problem of predicting analytically the effect of these stresses on the actual fatigue strength of helical springs has received but little attention. There has, however, been a general opinion among spring engineers, based on experience, that the use of the factor K of Fig. 1 will result in too low values of the permissible working load. This view was confirmed to a certain extent by the results of a series of carefully made fatigue tests on small helical springs of different indexes carried out by Zimmerli[6] which showed that the limiting stress range in fatigue, when figured by

Contributed by the Special Research Committee on Mechanical Springs for presentation at the Annual Meeting of The American Society of Mechanical Engineers held at New York, N. Y., December 5-9, 1938.

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Note: Statements and opinions advanced in papers are to be understood as individual expressions of their authors, and not those of the Society.

[2] "Stresses in Heavy Closely Coiled Helical Springs," by A. M. Wahl, Trans. A.S.M.E., vol. 51, part 1, 1929, paper APM-51-17, pp. 185-200.

[3] "Beanspruchung zylindrischer Schraubenfedern mit Kreisquerschnitt," by A. Röver, V.D.I. Zeit., vol. 57, November, 1913, p. 1907.

[4] "Die Berechnung zylindrischer Schraubenfedern," by O. Göhner, V.D.I. Zeit., vol. 76, March, 1932, p. 269.

[5] The present discussion will be limited to close-coiled springs, i.e., the effects of pitch angle are neglected. This is permissible for most practical springs.

[6] "Relation of Wahl Correction Factor to Fatigue Tests on Helical Compression Springs," by F. P. Zimmerli, Trans. A. S. M. E., vol. 60, January, 1938, paper RP-60-2, pp. 43-44.

using the K-factor, was higher for the springs of smaller indexes. Similar results were reported by Edgerton[7] in connection with the fatigue testing work being done on heavy helical springs by the A. S. M. E. Special Research Committee on Mechanical Springs. These tests will be discussed later.

✦ ✦ ✦

AN increase in the limiting stress range[8] with decrease in spring index may, in the author's opinion, be explained by the fact that in helical springs the stresses as computed by the factor K are very much localized at the inside of the coil; for this reason the factor K may be considered to act in some degree as a stress-concentration factor. Fatigue tests[9] made in recent years on specimens having stress concentration indicate that the latter may be neglected in computing the static component of the applied stress.[9] In Fig. 2 are shown the results of some fatigue tests made on 0.7 per cent carbon-steel bars[10] in tension - compression. The full lines represent tests on bars without notches, the lower curve representing minimum and the upper curve maximum values of the limiting stress range. The dot-and-dash line represents the static or mean component of the applied stress, while the difference between this line and either the upper or lower curve represents the variable stress component. When the bars are notched, thus producing stress concentration, the endurance range is reduced as shown by the dashed lines on this figure, all stresses being figured in this case by neglecting the stress concentration due to the notch. It will be noted that the static component of stress as represented by the dot-and-dash line is practically unchanged by the presence of the notch; the effect of the notch is mainly to reduce the amount of variable stress which can be carried by the test piece, corresponding to some stress-concentration factor. Thus, in this case, it is seen that the static stress may be figured by neglecting stress-concentration effects while the latter must, however, be considered in calculating the variable stress.

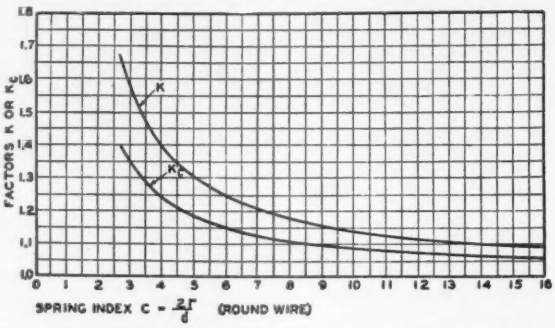

Fig. 1. Curve for Determining Factors K or K_c for Helical Tension or Compression Springs. (The factor K includes both the effects of curvature and direct shear; the factor K_c includes stress-concentration effects due principally to curvature.)

✦ ✦ ✦

SINCE practical helical springs are always under a combination of static and variable loading, if we neglect stress-concentration effects due to bar curvature the result is a higher permissible working stress (figured by using the K-factor of Fig. 1).

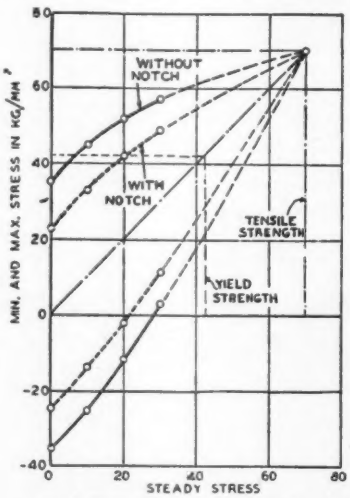

Fig. 2. Notch Effect in Fatigue Stressing With Initial Tension. (For 0.7 per cent carbon steel. According to tests by Schenck referred to in footnote 10.)

✦ ✦ ✦

A FURTHER reason why the factor K cannot be directly applied in spring design lies in the fact that some materials, particularly in the smaller specimens, when tested in fatigue do not show the full stress-concentration effects predicted by theoretical methods (strain measurements, photoelastic tests, or mathematical analysis). This lack of sensitivity to stress concentration is a function of both wire or bar size and material,[11] the finer-grained high-strength alloy steels showing much higher sensitivity than the coarse-grained medium-carbon steels.

✦ ✦ ✦

Method of Calculation Assuming Full Sensitivity to Stress Concentration

IN accordance with the previous discussion, a method of calculation for helical springs is suggested. This method, which is similar to the general one proposed by Soderberg,[12] is based on the following assumptions: (1) Stress-concentration effects due principally to curvature in helical springs may be neglected in figuring the static component of the stress; (2) the relation between the values of static- and variable-stress components at failure follows a linear law; (3) the tensile and fatigue properties of the wire are the same in springs of different indexes, assuming the same size wire; (4) the effects of eccentricity of loading due to the end turns are

[7] "Abstract of Progress Report No. 3 on Heavy Helical Springs," by C. T. Edgerton, Trans. A.S.M.E., vol. 59, October, 1937, paper RP-59-8, pp. 609-616.

[8] It is assumed that all spring stresses are calculated by using the factor K of Fig. 1.

[9] See discussion by R. E. Peterson of the "Report of Research Committee on Fatigue of Metals," Proceedings of the American Society for Testing Materials, vol. 37, 1937, p. 162. Also: "General Considerations in Designing Mechanical Springs," by A. M. Wahl Machine Design, vol. 10, January, 1938, pp. 30-35, and February, 1938, pp. 36-41.

[10] According to tests by Schenck; see "Federstähle" by Houdremont and Bennek, Stahl und Eisen, vol. 52, 1932, p. 660.

[11] For a discussion of "size effect" see the paper: "Model Testing as Applied to Strength of Materials," by R. E. Peterson, Trans. A.S.M.E., vol. 55, 1933, paper APM-55-11, pp. 79-85. Also: "Two and Three-Dimensional Cases of Stress Concentration, and Comparison With Fatigue Tests," by R. E. Peterson and A. M. Wahl, Journal of Applied Mechanics, Trans. A.S.M.E., vol. 58, March, 1936, p. A-15; and the discussion of this latter paper, Journal of Applied Mechanics, Trans. A.S.M.E., December, 1936, p. A-146.

neglected; (5) residual stresses produced by overstressing or surging the springs may be neglected. These factors will be more fully discussed later.

✦ ✦ ✦

TO determine the stress-concentration effect (due mainly to curvature) the stress multiplication factor K, shown in Fig. 1, is first split up into two parts, thus

$$K = K_s K_c \quad [1]$$

where K_s is a factor which takes into account the average stress produced by the direct shear due to the axial load, and K_c is a factor which takes into account the stress-concentration effect due mainly to curvature. Since the stresses due to direct shear are not localized, as is the case with those due to curvature, it is not believed that the factor K_s may be neglected in figuring the static component of stress. Assuming the shear stress due to the axial load as uniformly distributed over the cross section of the wire, the stress due to direct shear is[13]

$$s_s = \frac{16Pr}{\pi d^3}\,\frac{0.5}{c} \quad [2]$$

where the term $16Pr/\pi d^3$ is the stress figured by the conventional spring formula and c is the spring index $2r/d$. Thus

$$K_s = 1 + (0.5/c) \quad [3]$$

and from Equation [1]

$$K_c = \frac{K}{K_s} = \frac{K}{1 + (0.5/c)} \quad [4]$$

The factor K_c is shown in Fig. 1 as a function of the spring index c.

✦ ✦ ✦

REFERRING to Fig. 3, the dashed line shows a typical experimental curve of failure for materials under a combination of static and variable stress. The ordinates represent values of variable stress which will just cause failure when superimposed on the static stresses shown by the abscissas. Assume that fatigue tests are made on a spring of large index ($c = \infty$) so that $K_c = 1$. Let s'_e denote the endurance limit in pulsating stress (zero to maximum) obtained on this spring. Then the point P on the diagram is determined, since for this case (pulsating stress) both the static- and variable-stress components are equal to $s'_e/2$. As an approximation, we replace the experimental curve by the straight line PA drawn to intersect the axis of abscissas at s_y, the yield point of the material in torsion. This is done since in general no stress should exceed the yield point.[14]

✦ ✦ ✦

TO apply this diagram in actual design, assume that the spring is operating under a stress range from s_{min} to s_{max} in fatigue where these stresses are figured by using the factor K. Then the variable stress s_v is

$$s_v = \frac{s_{max} - s_{min}}{2} \quad [5]$$

and the static stress is

$$s_o = \frac{s_{max} + s_{min}}{2K_c} \quad [6]$$

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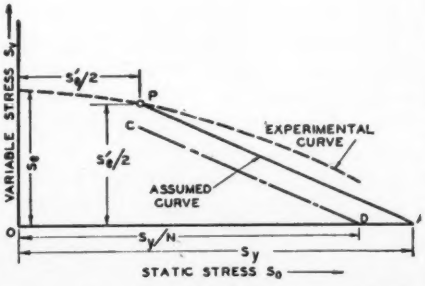

Fig. 3. Application of Straight-Line Law to Helical Springs When the Endurance Limit s'_e for Pulsating Load Applications (Zero to Maximum) and the Yield Stress s_y Are Known. (All stresses are torsion stresses.)

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THE right side of the last equation is divided by K_c since this factor has already been used in figuring s_{max} and s_{min}; therefore, to neglect stress-concentration effects due to curvature, division by K_c is necessary. The equation for the line PA, shown in Fig. 3, in terms of s_o and s_v is

$$\frac{s_o}{s_y} + \frac{s_v}{\frac{s'_e}{2}\left[\frac{s_y}{s_y - (s'_e/2)}\right]} = 1 \quad [7]$$

Substituting the values of s_v and s_o given by Equations [5] and [6] we find

$$s_{max} = \frac{2s_y}{\frac{1}{K_e}\left(1 + \frac{s_{min}}{s_{max}}\right) + \left(\frac{2s_y}{s'_e} - 1\right)\left(1 - \frac{s_{min}}{s_{max}}\right)} \quad [8]$$

This equation gives the maximum stress[15] s_{max} in terms of K_c, s_y, s_{min}/s_{max}, and s_y/s'_e and may be written

$$s_{max} = C_w s'_e \quad [9]$$

where C_w is a function of K_c, s_y, s_{min}/s_{max}, and s_y/s'_e. Thus

✦ ✦ ✦

$$C_w = \frac{2s_y/s'_e}{\frac{1}{K_e}\left(1 + \frac{s_{min}}{s_{max}}\right) + \left(\frac{2s_y}{s'_e} - 1\right)\left(1 - \frac{s_{min}}{s_{max}}\right)} \quad [10]$$

SINCE K_c is a function of spring index c, values of C_w may be plotted in the form of charts for various spring indexes and various values of s_y/s'_e.

✦ ✦ ✦

FOR design purposes we introduce a factor of safety N so that the working stress becomes

$$s_{w\,max} = C_w(s'_e/N) \quad [11]$$

It may be shown that this amounts to assuming a curve CD, shown in Fig. 3, parallel to the line PA and intersecting the axis of abscissas at at distance s_y/N from O.

✦ ✦ ✦

CHARTS showing the relation between C_w and s_{min}/s_{max} for various spring indexes at given values of s_y/s'_e are shown in Figs. 4, 5, and 6. Thus in Fig. 5 the ratio s_y/s'_e is taken equal to 2. These charts show clearly how the maximum permissible stress increases with increase in s_{min}/s_{max} and that this increase is greater for the springs of smaller index.

[12] "Working Stresses," by C. R. Soderberg, Trans. A.S.M.E., vol. 55, 1933, paper APM-55-16, pp. 131-144. Also: "Working Stresses," by C. R. Soderberg, Journal of Applied Mechanics, Trans. A.S.M.E., vol. 57, September, 1935, p. A-106.

[13] All stresses considered in this analysis are torsion stresses.

[14] The ultimate strength in torsion could be substituted for s_y if desirable. In some cases this would give results in closer agreement with tests, but the results obtained by using the yield point will, in general, be on the safe side.

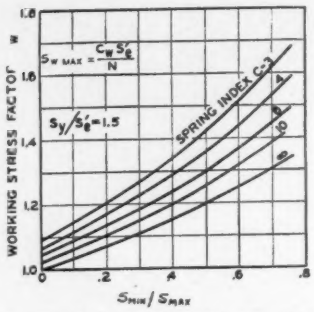

Fig. 4. Chart for Determining the Working-Stress Factor C_w for $s_y/s'_e = 1.5$ and $q = 1$. (Full Sensitivity).

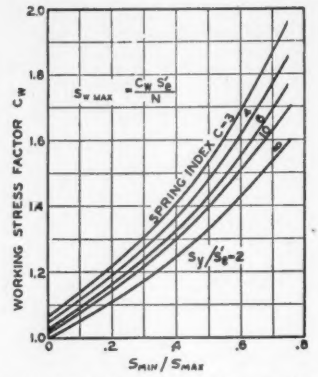

Fig. 5. Chart for Determining the Working-Stress Factor C_w for $s_y/s'_e = 2$ and $q = 1$. (Full Sensitivity).

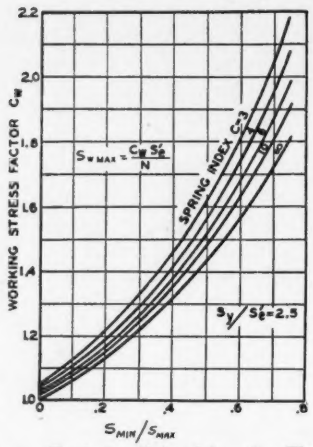

Fig. 6. Chart for Determining the Working-Stress Factor C_w for $s_y/s'_e = 2.5$ and $q = 1$. (Full Sensitivity).

Method of Calculation Where Material Is Not Completely Sensitive to Stress Concentration

A SIMILAR procedure may be used for cases where the material is not completely sensitive to stress concentration. While fatigue tests on actual springs will be required to determine the actual sensitivity to stress concentration of the various materials made in various wire sizes, it may be expected that the sensitivity will be lower for the smaller wire sizes and for the coarser grained carbon steels, and higher for the larger sizes and the fine-grained alloy steels.

✦ ✦ ✦

THE sensitivity to stress concentration may be measured by the so-called "sensitivity index" q defined as[16]

$$q = \frac{K_f - 1}{K_c - 1} \qquad [12]$$

where K_f is the fatigue strength reduction factor, i.e., the effective stress-concentration factor as determined by fatigue tests, and K_c is the theoretical stress-concentration factor as determined by strain measurements or mathematical analysis. For materials completely insensitive to stress-concentration, $K_f = 1$ and from Equation [12] $q = 0$, while for complete sensitivity $K_f = K_c$ and $q = 1$. Intermediate cases are represented by values of q between zero and unity.

✦ ✦ ✦

TO introduce the sensitivity index q in the expression for s_{max} in Equation [8], we note that in figuring the variable stress s_v we are to use the fatigue strength-reduction factor K_f rather than the theoretical stress-concentration factor K_c. But s_{max} and s_{min} have already been calculated by multiplying the nominal stress by the factor K which includes K_c. Hence, we must multiply the value given by Equation [5] by the ratio K_f/K_c. This gives

$$s_v = \left(\frac{s_{max} - s_{min}}{2}\right)\frac{K_f}{K_c} \qquad [13]$$

But from Equation [12]

$$K_f = 1 + q(K_c - 1) \qquad [14]$$

Substituting Equation [14] in Equation [13]

$$s_v = \left(\frac{s_{max} - s_{min}}{2}\right)\left(\frac{1 + q(K_c - 1)}{K_c}\right) \qquad [15]$$

Using Equations [15] and [6] in Equation [7] we find

$$s_{max} = \frac{2s_y}{\frac{1}{K_c}\left(1 + \frac{s_{min}}{s_{max}}\right) + \left(\frac{2s_y}{s'_e} - 1\right)\left(1 - \frac{s_{min}}{s_{max}}\right)\left(\frac{1 + q(K_c - 1)}{K_c}\right)} \qquad [16]$$

IT is seen that where $q = 1$ (full sensitivity) Equation [16] reduces to Equation [8]. For $q = 0$ (no stress-concentration effect), the denominator of this equation is in effect divided by K_c, which means that stress-concentration effects due to curvature as represented by K_c are neglected entirely both for the static- and variable-stress components.

✦ ✦ ✦

FROM Equation [16] we also obtain Equation 17 (See bottom of page)

This also reduces to Equation [10] when $q = 1$.

✦ ✦ ✦

CHARTS showing C_w as a function of spring index c for $q = \frac{1}{2}$ and for s_y/s'_e equal to 1.5, 2.0, and 2.5 are given in Figs. 7, 8, and 9, respectively. These charts are given merely as examples to show the effect of a reduction in the sensitivity of the material, as measured by the index q, on the allowable stress.

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Example of Application of Charts

TO illustrate the application of the charts shown in Figs. 4,

$$C_w = \frac{2s_y/s'_e}{\frac{1}{K_c}\left(1 + \frac{s_{min}}{s_{max}}\right) + \left(\frac{2s_y}{s'_e} - 1\right)\left(1 - \frac{s_{min}}{s_{max}}\right)\left(\frac{1 + q(K_c - 1)}{K_c}\right)} \qquad [17]$$

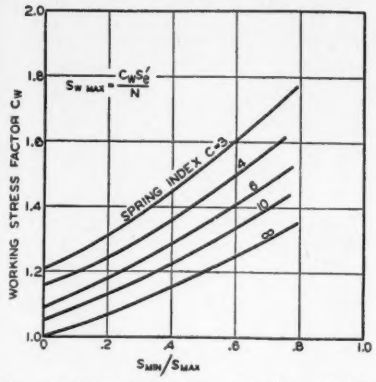

Fig. 7. Chart for Determining the Working-Stress Factor C_w for $s_y/s'_e = 1.5$ and $q = ½$.

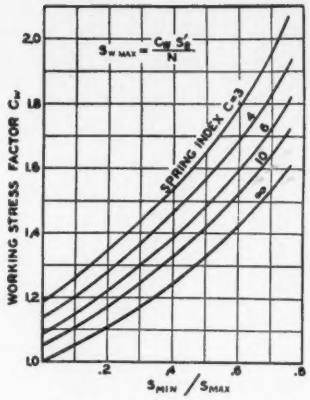

Fig. 8. Chart for Determining the Working-Stress Factor C_w for $s_y/s'_e = 2$ and $q = ½$.

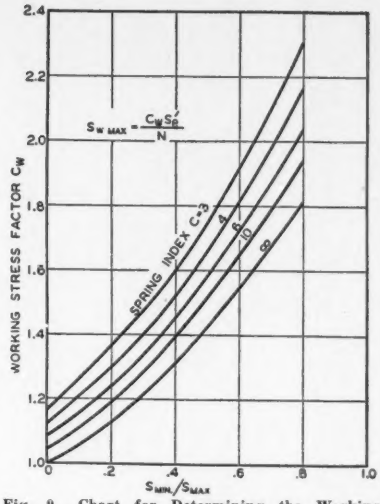

Fig. 9. Chart for Determining the Working-Stress Factor C_w for $s_y/s'_e = 2.5$ and $q = ½$.

5, and 6 in practical work, let us assume we have a spring of ¼-in. wire diameter and ¾-in. mean coil diameter, i.e., $c = 3$. Assume that fatigue tests on springs of large index and on the same size wire subjected to a pulsating load (zero to maximum) yield of value of endurance limit $s'_e = 60{,}000$ lb. per sq. in., while torsion tests show a yield point in torsion[17] of 120,000 lb. per sq. in. Assume further that the spring is under a fatigue range from s_{min} to s_{max}, where $s_{min} = 0.5\ s_{max}$. To be on the safe side, we assume full sensitivity of the material ($q = 1$). Since $s_y/s'_e = 2$, we use the chart shown in Fig. 5 and from this chart for $c = 3$, $s_{min}/s_{max} = ½$, we find $C_w = 1.53$. Thus, from Equation [9], we may on this basis expect fatigue failure at $s_{max} = C_w s'_e = 1.53 \times 60{,}000 = 92{,}000$ lb. per sq. in. Assuming a factor of safety $N = 1.5$, the working stress, from Equation [11], would be $s_{w_{max}} = C_w s'_e/N = 92{,}000/1.5 = 61{,}000$ lb. per sq. in., this stress being calculated by using the K-factor of Fig. 1. If the spring index were 10 instead of 3, the factor C_w would, from Fig. 5, be 1.39 and the working stress $s_{w_{max}} = (1.39 \times 60{,}000)/1.5 = 56{,}000$ lb. per sq. in., assuming a factor of safety $N = 1.5$.

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TO show the effect of a reduction in the q factor, let us assume that endurance tests on springs of smaller index in this particular wire size show a value of $q = ½$. Then, using the chart shown in Fig. 8, ($s_y/s'_e = 2$, $q = ½$) we find $C_w = 1.65$ for $c = 3$ and $s_{min}/s_{max} = ½$. In this case, the allowable working stress, using a factor of safety $N = 1.5$, would be $s_{w_{max}} = C_w s'_e/N = (1.65 \times 60{,}000)/1.5 = 66{,}000$ lb. per sq. in.

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Discussion of Limitations of Method for Finding C_w

THE method of design previously discussed is based on the assumption of a linear relation between the static- and variable-stress components necessary to cause fatigue failure, i.e., the line PA in Fig. 3 is assumed. Usually the experimental results will be somewhat above this line as indicated. Hence, if the value of the zero to maximum endurance limit s'_e were determined by actual tests on a spring of large index and having the wire size under consideration, it appears that if the line PA were used as a basis the results would be on the safe side. In this connection it is necessary to determine the value of s'_e by tests on the actual wire size used, since the endurance values may change considerably between small and large sizes. It has also been assumed that the line of failure PA tends to approach the yield point in torsion. In some cases it may be found that this line tends to approach the ultimate strength in torsion.[18] In such cases the ultimate strength s_u could be used instead of s_y in applying the charts and formulas. If this were done, however, a higher factor of safety should be used than would be the case otherwise.

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IN deriving the formulas for C_w, it has been assumed that the endurance properties of the material do not change between springs of small and large index, assuming a given wire size. Although this appears to be a reasonable assumption, there are cases where it may not be strictly true. For example, in cold-wound springs made from a given size of wire, the springs coiled to the smaller diameters will be subjected to the greatest amount of cold working; hence, such springs may possess somewhat different endurance properties than would otherwise be expected. If a stress-relieving treatment were given, this difference would possibly be slight. A similar result may be expected where springs are quenched after coiling, since the effect of the heat treatment may be different for springs of different indexes.

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IT is common practice, in the manufacture of compression springs, to compress the spring

[15] It is assumed that the variable component of stress is not greater than the static component, i.e., only stress conditions corresponding to the line PA in Fig. 3 are considered.

[16] See the second reference of footnote 11 for a discussion of "sensitivity index."

[17] If the yield point is not sharply defined it may, as an approximation, be taken as that point where the plastic strain is 0.2 per cent. See the paper: "Concerning the Yield Point in Tension," by J. M. Lessells, Proceedings of the American Society for Testing Materials, vol. 28, part 2, 1938, p. 387.

solid, thus giving it a permanent set. The effect of this is to introduce residual stresses of opposite sign so that when the spring is under the working load, the peak stress will be reduced by the amount of such residual stresses. For this reason the tendency will be for the fatigue strength to be increased because of the presence of these stresses. Because of the sharper curvature of the springs having smaller indexes, it will be easier to introduce such residual stresses in these springs, and for this reason it may happen that the fatigue strength of the springs of smaller index may be increased by such treatment to a relatively greater extent than is the case for springs of large index. Such effects may be taken into account by changes in the sensitivity index q when more test data are available.

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IN the present analysis, the effects of eccentricity of loading due to the presence of the end turns have been neglected. Some years ago the author had occasion to make a series of tests to determine eccentricity of loading in small helical springs in compression. It was found that such eccentricities may increase the maximum stress from 4 to 30 per cent, depending on the shape and form of the end turns, and the total number of turns; considerable scatter was evident in the results. For an accurate check of the effects of wire curvature on the endurance, it would seem desirable to make provision for applying central loads to springs under fatigue test in order to eliminate the disturbing effects due to eccentricity of loading which may tend to mask the effects due to wire curvature. In this connection, reference may be made to the torsional fatigue tests carried out on spring wires by **Weibel.**[19] These tests showed endurance limits in zero to maximum torsion of about 105,000 lb. per sq. in. compared with values around 65,000 lb. per sq. in. obtained on complete springs made from the same material by **Zimmerli.**[18] As mentioned by **Weibel**, part of this difference may be due to internal stress in the cold-wound spring and part may be due to the greater probability of the presence of serious flaws in the complete spring. It is the author's opinion, however, that eccentricity of loading of the complete spring may also play an important part in explaining this very considerable difference. Such eccentricity would lower the endurance limit of the complete spring in comparison to that which is obtained in simple torsion tests on straight specimens.

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Comparison With Test Results

TO the author's knowledge the most comprehensive series of tests yet made to check the effect of spring index on endurance strength of helical springs are those carried out by **Zimmerli**[6] who made a series of tests on springs of 0.148-in. diameter pretempered Swedish valve-spring wire with indexes c varying from 3.5 to 12. It will be of interest to compare these test results with those obtained by the application of the charts shown in Figs. 4, 5, and 6, which assume full sensitivity to stress concentration ($q = 1$). Values of the minimum and maximum points (s_{min} and s_{max}) of the limiting stress ranges as found by **Zimmerli**[6] for the various indexes are given in the second and third columns of Table 1. To determine the zero to maximum endurance limit s'_e, for a spring of large index, we use the test results for $c = 11.9$ as a basis, taking $s_{min} = 19{,}000$ lb. per sq. in., $s_{max} = 91{,}000$ lb. per sq. in., and $s_{min}/s_{max} = 0.21$. Assuming tentatively $s_y/s'_e = 1.5$, we find, from Equation [8], $s_{max} = 1.11\ s'_e$ for $s_{min}/s_{max} = 0.21$. Solving, $s'_e = 91{,}000/1.1 = 82{,}700$ lb. per sq. in. Since the yield point in torsion for this material will be around 120,000 lb. per sq. in. (or somewhat above the elastic limit in torsion) we may assume $s_y/s'_e = 1.5$ with sufficient accuracy and use the chart shown in Fig. 4. Using this value of s'_e and assuming the minimum values of the stress range (s_{min}) as given, the limiting values of maximum stress s_{max} were computed using the chart shown in Fig. 4 and Equation [9]. (Equation [8] may also be used for calculation.) The computed values of s_{max} thus found are given in the fifth column of Table 1. For comparison, values of the limiting stress range $s_{max} - s_{min}$ as found by **Zimmerli**,[6] and as determined by calculation, are given in the last two columns of Table 1.

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A COMPARISON of the figures in the last two columns of Table 1 indicates that the test and calculated values of limiting stress range differ by only a few per cent. This offers some indication that the method of determining working stress by using Equation [8], which assumes full sensitivity to stress concentration ($q = 1$), will give results in fair agreement with actual fatigue tests, at least for some materials and wire sizes.

TABLE 1

Spring Index c	Limiting stresses[a] from Zimmerli's fatigue tests[b]		Calculated values of limiting stresses (using Fig. 4)		Limiting range in stress $s_{max} - s_{min}$	
	s_{min}	s_{max}	s_{min}	s_{max}	By test (Zimmerli)[b]	Calculated (Fig. 4)
3.50	14000	100000	14000	95500	86000	81500
4.55	19000	94000	19000	96000	75000	77000
7.00	19000	93000	19000	93500	74000	74500
9.10	19000	90000	19000	92000	71000	73000
11.90	19000	91000	19000	91000	72000	72000

[a] These stresses figured using the K-factor.
[b] See footnote 6.

[18] "Permissible Stress Range in Small Helical Springs," by F. P. Zimmerli, Engineering Research Bulletin No. 26, University of Michigan, Ann Arbor, Mich.

[19] "The Correlation of Spring-Wire Bending and Torsion Fatigue Tests," by E. E. Weibel, Trans. A.S.M.E., vol. 57, November, 1935, paper RP-57-1, pp. 501-516.

THE tests by **Edgerton** mentioned previously[7] were made on two groups of springs coiled from ¾-in. diameter bar stock, one group of index 3 and the other of index 5. The endurance limits calculated by the use of the conventional formula were practically the same for the two groups of springs, while the endurance limits calculated by using the K-factor differed considerably. This would indicate that for these springs neither the bar curvature nor the direct shear stress have any effect on the endurance. As mentioned by **Edgerton**,[7] this is a most surprising conclusion, and further check tests are necessary. Since the tests by **Zimmerli**[6] discussed previously do show a definite effect on the endurance properties produced by wire curvature, even in small springs, it would seem that a more comprehensive series of tests should be made before drawing definite conclusions. In particular it would seem desirable to carry out a series of tests in which provision is made to obtain a centrally applied load on the spring in order to eliminate as much as possible the disturbing effects due to eccentricity of loading which, as mentioned previously, may tend to mask the effects produced by wire curvature.

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Conclusions

THE method described in this paper for determining the effect of bar or wire curvature on working stresses in helical springs under fatigue loading is suggested as a rational basis for the application of our present knowledge of the endurance properties of materials to this problem. While it is realized that the method may have to be modified in the light of future test results, it appears to yield reasonable results in certain cases when applied to existing fatigue-test data. Further fatigue tests wherein eccentricity of loading is eliminated would appear desirable in order to obtain a more accurate determination of the sensitivity index q for various wire sizes and spring materials. For design purposes, an additional factor to take eccentricity of loading into account may be introduced, but a discussion of this is beyond the scope of the present paper.

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Acknowledgment

THE author wishes to express his appreciation to **L. W. Chubb** and **R. E. Peterson** of the Westinghouse Research Laboratories for their interest and suggestions in connection with the preparation of this paper.

Celebrating its 50th Anniversary, the Keystone Steel & Wire Company of Peoria, Illinois gathered its entire sales force for one of the most successful sales conventions of its history. The meeting was held in Peoria, December 27, 28, 29 and salesmen from all sections of the country were in attendance.

Keynote of the meeting was the 50th Anniversary sales and advertising campaign opening this January. History of the Keystone Steel and Wire Company was traced from the first crude, hand-made fence weaving machine invented by Peter Sommer in 1889. Housed in a little frame shed on an Illinois farm, it was the first Keystone factory. Fifty years of fence making have seen it grow to the largest independent steel and wire mills in the world.

Advertising plans for the Spring season were presented, showing how the 50th Anniversary theme is to be carried out in farm paper, radio, direct mail, trade paper and all advertising media.

Highlight of the three-day session was the Founder's Day banquet held Wednesday evening, Dec. 28, when the sales force was joined by a large delegation from the Keystone plant and offices. ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

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WIRE AND WIRE PRODUCTS

17 East 42nd St. NEW YORK, N. Y.

Outstanding Personalities of the Wire Industry

Harry M. Francis

HARRY M. FRANCIS was born in Brooklyn, N. Y., July 13, 1897. He was graduated from Erasmus Hall High School in that city and attended City College of New York.

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HE entered the employ of the American Steel & Wire Co. as a messenger in the New York Office in 1915, and later became a salesman. Subsequently Mr. Francis was transferred to Philadelphia as Assistant Manager of Sales, and then returned to New York in 1925.

✦ ✦ ✦

IN July, 1927, he was transferred to the Boston Office of the company as Manager of the Manufacturers Trade Department, and in 1934 became New England District Manager of Sales. He remained in that capacity until April, 1937, when he was promoted to the position of Assistant General Manager of Sales with headquarters in the Company's main offices in Cleveland. His appointment as Assistant Vice-President —Sales was made in December 20, 1938.

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W. W. Modrow

IT is with deep regret that we announce the death of Mr. W. W. Modrow, Vice-President and Manager of the Drawn Metal Specialty Co., Inc., Waterbury, Connecticut.

✦ ✦ ✦

Albert R. Breen

FIDELITY Machine Company of Philadelphia announce the appointment of Mr. Albert R. Breen, with offices at 80 East Jackson Boulevard, Chicago, Illinois, as exclusive sales agent for the Middle-Western States of its varied line of products.

✦ ✦ ✦

MR. BREEN will give particular attention to the Fidelity line of Braiding, Winding and

HARRY M. FRANCIS
Assistant Vice- President, Sales
American Steel & Wire Company
Subsidiary of United States Steel Corp.

Spooling Machines. Of particular interest at this time is the recent development of the Sinfra High Speed Wire & Cable Covering Machines.

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MR. BREEN is an experienced engineer by profession and since 1920 has been known as a specialist in the textile industry. He was an executive of the Universal Winding Company of Providence, R. I., for many years and since 1934 has represented a number of important companies in the Middle West including Universal Winding Company, U. S. Bobbin & Shuttle Company, Sonoco Products Company, National Ring Traveler Company, Page-Madden Company, Inc., and others.

ALBERT R. BREEN
Midwestern Representative
Fidelity Machine Co., Philadelphia, Pa.

✦ ✦ ✦

John F. Baker

JOHN F. Baker, formerly with Surface Combustion Corporation, is now representing the Ajax Electric Company, Inc., in the Pittsburgh District.

✦ ✦ ✦

Irvin C. Kinney

IRVIN C. Kinney has been appointed manager of sales for the sheet and wire products division of the Tennessee Coal, Iron & Railroad Company, Birmingham, Ala. He was formerly advertising manager.

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William Farnsworth and J. H. Kennedy

PROMOTION of W. M. Farnsworth, formerly superintendent of the electric furnace department of the Republic Steel Corporation, to general superintendent of the company's Canton plant, succeeding B. R. Richardson, deceased, has been announced by C. M. White, vice president in charge of operations. Mr. Farnsworth will be succeeded by J. H. Kennedy.

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A. G. Delaney and G. H. Davis

A. G. Delaney, superintendent of maintenance, Gulfsteel division of Republic Steel Corporation, has been named assistant district manager under E. I. Evans, recently appointed manager. G. H. Davis becomes master mechanic, heading mechanical department of the Gulfsteel division. C. R. Fletcher is advanced to mechanical general foreman.

Wire Association Questions & Answers

Question 4231

Standard Test Showing Tightness of Tin Coating on Steel Wire

To The Wire Association:

"We manufacture thin Telephone Cables, consisting of a core of .020 hot tinned copper wire and 8 hot tinned .0125 wires. Two of them are copper and six are steel (285,000-310,000 p. s.i.) This strand is covered with two layers of vulcanized india rubber and one layer of cotton. The tin coating has to protect the steel against the influence of the sulphur of the india rubber, therefore it has to be impervious and without any pore.

What we want to know: Is there any standard test for the hot tinned steel wires, that shows the tightness of the tin coating? We know the test with a hot, acidulated solution of agar-agar and K4Fe (CN)6.3H20, that produces blue spots where the steel is not tin covered. But this test seems to us not to be satisfactory."

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Answer No. 1

"WOULD advise that we know of no better standard test for showing the porosity of tin coating than the agar-agar potassium ferrocyanide solution.

For any further tests on this subject, I suggest that you communicate with the manufacturers of tin plate."

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Answer No. 2

WITH reference to your inquiry, the enclosed bulletin published by the Iron and Steel Institute of Great Britain entitled "The Determination of the Porosity of Tin Coatings on Steel", may be of assistance to you.

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Answer No. 3

REFERRING to the query of your correspondent, your attention is invited to the attached copy of U. S. Army Specification 71-263-A, November 5, 1928 which sets forth in detail the procedure now accepted as the standard tinning test for iron and steel wire indicating both adhesion and coverage.

Particular attention is invited to Par. 3 of the subject specification and to the last sentence on Page 2. Strict adherence by our inspectors to the procedure set forth therein has produced entirely satisfactory results.

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Question No. 4232

Production of Copper Tubing

To The Wire Association:

1—Is all copper tubing in the final size produced by extruding or drawing?

2—In the case where the extruding operation is used, at what size does the drawing operation start?

3—How is it done and what kind of dies are used?

4—Where can drawing machinery for fine copper tubes be purchased?

The Wire Association is for the specific purpose of improving production methods. It is organized as a clearing house of ideas on technical problems and research work in all phases of practical wire drawing and wire working.

The inquiries discussed were received from and answered by members of the Wire Association. These inquiries are sent to the Secretary of the Association who acts as a central clearing point, and neither the names of the firms or individuals sending in the inquiry, or of the men or firms replying are divulged without permission.

Answer No. 1

"ANSWERING your letter regarding questions on Copper Tubing, I am giving you the answers below:

1. Copper tubing in the final size is produced by drawing.

2. Drawing operations start about 3½" O. D., .300" Gauge.

3. It is done on a chain draw bench on hardened steel dies.

4. Drawing machines for fine copper tubing can be purchased from the Waterbury Farrel Foundry."

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Answer No. 2

"REGARDING the manufacture of copper tubing, we have gathered the following data from local and other sources:

1. The production of the copper tube by the extrusion process is obsolete and it is now made almost exclusively by the Mannesmann Process from cast bars. These tubes are finished by drawing, as they are more or less spirally rough surface as they come from the Mannesmann Machine.

2. In regard to the size, the Mannesmann tube may run from ½" to 1" over the size of the finished drawn tube.

3. The dies are steel and a mandrel is used practically in all sizes in order to get uniform size.

4. Wire drawing machinery for fine copper tubes can be purchased from the Waterbury Farrel Foundry & Machine Company."

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Answer No. 3

"IN your first question you ask if all copper tubing in the final size is produced by extruding or drawing, and our answer to this is that both processes are used by some manufacturers. Your second question is where the drawing operation starts from the extruded size, and our answer to this is also indefinite as many manufacturers have varying processes and much copper tubing is produced from other processes than extruding so that it would depend entirely on what class of material was desired. Your third question evidently inquires about the method of drawing copper tube. Most copper tube that is drawn, is made on a standard drawing bench using bell shaped dies made of tool steel with supporting mandrels on the inside of the tubing. Your fourth question inquires a source for a machine for drawing and we are glad to advise that the Standard Machinery Company of Auburn, Rhode Island, manufacture draw benches for just this purpose."

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"PRACTICALLY all copper tubing is finished by cold drawing. The sizes at which cold drawing starts depend largely on the size to be finished. On the larger sizes I believe steel dies are usually used and on the smaller sizes tungsten carbide dies have come into general use.

As far as machinery for drawing this is concerned, I think it depends largely upon the process that is used. I am sorry that I can give you very little information. I do know that ordinarily chain draw benches are used in drawing the larger sizes in relatively short lengths."

Question No. 4233

Corrosion of Common Pins

The Wire Association:

"I am interested in a particular type of corrosion of the straight common plated steel-base pin.

The pins in question are retailed in bulk in small cardboard boxes whose size is approximately 1"x2"x5". After a few months' storage and the boxes are opened, some of the pins are found to be rusted, especially at the tapered points.

I am trying to ascertain whether the corrosion is due to (1) chemicals—such as alum or acid radicals—in the cardboard of the box, or to (2) moist atmosphere. I would be deeply grateful to you for any information or literature references you may kindly send me which would enlighten me as to the definite cause of this rusting."

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Answer No. 1

"WHILE we have had no experience with pins rusting, we do know from difficulties we have had with other small parts made from wire, that there are several possible causes for the corrosion.

If the parts are perfectly plated so that there are no microscopic holes through the plate, the parts are not likely to be affected a great deal by atmospheric conditions. However, if there are holes in the surface, no matter how small, the steel is bound to rust if it comes in contact with a humid atmosphere. This is particularly likely to occur during the Summer months, if the parts are not stored in a dry place.

It might be possible for chemicals to affect the surface, but this is unlikely, unless there is moisture present, and it would seem that the pins would become affected all over, and not necessarily only at the point."

(Please turn to Page 132)

Exports and Imports of Wire

Exports of Iron and Steel Wire Products in Nov. 1938 and Nov. 1937 (in gross tons)

	NOV. 1938	OCT. 1938	NOV. 1937
Wire rods	1,600	1,232	6,445
Strip steel	5,877	6,121	7,105
Plain, black or galvanized iron or steel wire	5,881	5,124	3,232
Barbed wire and woven wire fencing	3,954	4,417	1,807
Woven wire screen cloth	110	124	66
Wire rope	278	235	358
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	818	428	475
Wire nails	2,122	2,040	685
Tacks	21	36	46
Other nails, including staples	467	351	187
Bolts, machine screws, nuts, rivets and washers	665	674	779
Total, these 11 classifications	21,793	20,782	21,185

Imports of Iron and Steel Wire Into the United States (in gross tons)

Concrete Reinforcement Bars	114	86	43
Hollow bar and drill steel	133	79	188
Wire rods	803	415	1,405
Barbed wire	559	973	1,446
Round iron and steel wire	252	199	250
Telephone and telegraph wire	7	2	.....
Flat wire and strip steel	302	243	669
Wire rope and strand	157	162	188
Other wire	208	114	97
Hoops and bands	1,658	1,079	1,582
Nails, tacks and staples	842	414	552
Bolts, nuts and rivets	21	30	16
Total, these 12 classifications	5,056	3,796	6,436

Exports of Insulated Wire and Cable, November, 1938

	Foreign		To U. S. Possessions	
	Pounds	Dollars	Pounds	Dollars
Rubber covered wire	380,707	$ 91,450	104,786	$25,153
Weatherproof wire	241,422	38,932	72,280	11,795
Other insulated copper wire	456,399	77,960	117,453	19,557
Nickel-chrome electric resistance wire	60,653	57,803	.....	.....
Total, these 4 classifications	1,139,181	$266,145	294,519	$56,505

Exports

THE leading products exported in November were, in order of tonnage, pig iron, skelp, non-alloy black steel sheets, non-alloy "other" plates, and tin plate and taggers' tin. Hungary (13,825 tons) was the principal purchaser of pig iron (whose total of 38,383 tons was but 60 percent as large as in October), followed by France (10,000 tons), Japan (9,140 tons), and Belgium (2,594 tons). Skelp shipments were sharply increased at 24,706 tons—Canada being the only taker of record.

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MANY countries participated in the 21,984-ton trade in non-alloy black steel sheets—the outstanding being Canada (6,461 tons), the U. S. S. R. (6,071 tons), the United Kingdom (2,683 tons), and Brazil (1,486 tons). Non-alloy "other" plate (20,961 tons) was also important in this trade with principal markets the Netherlands (8,361 tons), Poland (2,268 tons), Sweden (1,638 tons), and Canada (1,179 tons). The outstanding markets for tin plate and taggers' tin, the exports of which totaled 10,908 tons in November included Brazil (1,445 tons), Cuba (1,354 tons), the Netherlands (1,229 tons), and Mexico (1,035 tons).

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EXPORTS of scrap iron and steel (including tin plate scrap, tin plate circles, and waste-waste tin plate) totaled 450,001 tons in November, more than doubling the 223,954-ton trade of October and being far above the 255,311-ton trade of November, 1937.

THE November, 1938 total was made up of 448,020 tons of iron and steel scrap, 1,085 tons of tin plate scrap, 330 tons of tin plate circles, and 566 tons of waste-waste tin plate. The principal purchasers of the iron and steel scrap exported were Japan (318,736 tons), Italy (55,446 tons), Germany (30,515 tons), the Netherlands (16,408 tons), Poland and Danzig (12,690 tons), and Canada (11,067 tons). Japan also took all of the tin plate scrap exported and 122 tons of the tin plate circles—the balance (208 tons) going to China which was also the leading buyer of waste-waste tin plate with a total of 209 tons. Other purchasers of this last-named product included Hong Kong (134 tons), Canada (71 tons), and the Netherlands (56 tons).

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Imports

AT 22,878 gross tons November imports of iron and steel products (scrap excepted) topped the October total of 20,921 tons by 9.3 percent. On a value basis, however, the gain was less marked—the November total of $1,402,221 topping the $1,300,714 trade of the preceding month by 7.8 percent.

✦ ✦ ✦

FROM a tonnage standpoint the principal item imported was spiegeleisen (5,056 tons)—Canada supplying 4,889 tons and Norway 100 tons. Structural shapes (3,798 tons), the second largest tonnage of any imported item, came principally from Belgium (3,097 tons) and France (645 tons). Receipts of "other" pipe—1,709 tons—included 1,454 tons from Germany and 210 tons from Canada, while the 1,658-ton trade in "other" hoops and bands was made up in large part of shipments received from Belgium (1,192 tons), France (344 tons), and Germany (121 tons). Pig iron imports totaled 1,493 tons including 1,158 tons from the Netherlands, 150 tons from Sweden and 149 tons from British India.

FOR the second consecutive month Belgium was the leading supplier of iron and steel products to the United States, her 6,837-ton total including 3,097 tons of structural shapes, 1,192 tons of "other" hoops, and 1,148 tons of merchant bars. Canada with spiegeleisen (4,889 tons) as principal item was second supplier with a total of 5,284 tons, to be followed by Germany (3,283 tons of which 1,454 was "other" pipe), Norway (2,087 tons including 1,949 tons of ferromanganese), Sweden (1,651 tons including 602 tons of wire rods), France (with 645 tons of shapes in a total trade of 1,639 tons), and the Netherlands (1,500 tons of which 1,158 tons was pig iron).

✦ ✦ ✦

CARD CLOTHING receipts totaled 19,662 square feet valued at $30,978, against 17,822 square feet valued at $29,069, and came from the United Kingdom (18,916 square feet valued at $29,668) and the balance from Belgium.

✦ ✦ ✦

RECEIPTS of WIRE HEDDLES totaled nothing.

✦ ✦ ✦

A TRADE of 34,829 square feet valued at $6,864 resulted in WIRE CLOTH AND SCREENING against 49,760 square feet valued at $10,976 and came from the Netherlands, 18,147 square feet, and Germany, 10,691 square feet.

✦ ✦ ✦

FOURDRINIER AND OTHER PAPER-MAKING WIRE totaled nothing.

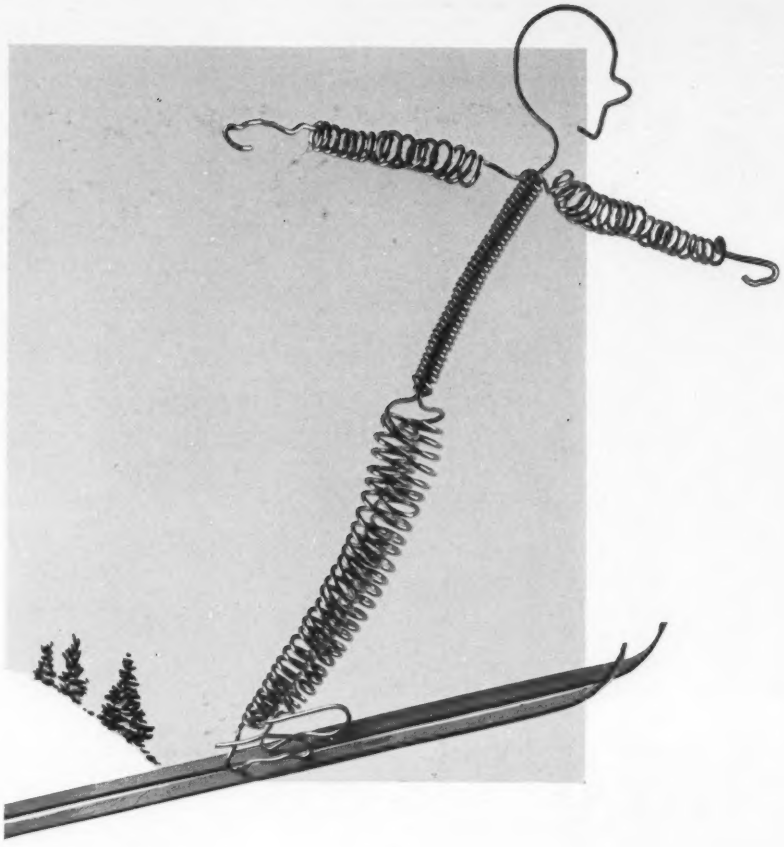
✦ ✦ ✦

RECEIPTS OF WIRE FENCING AND NETTING, galvanized before weaving amounted to nothing. Of that galvanized after weaving, the total was 1,099,252 square feet valued at $5,405 as against 931,300 square feet valued at $5,919 and came from Germany, 537,500; 409,500 square feet from the Netherlands, and 138,502 square feet from Belgium.

✦ ✦ ✦

EXPORTS of iron and steel wood screws during November, 1938 totaled 30,472 gross valued at $5,965. Of this total Cuba took 8,300

(*Please turn to Page 124*)



Wire **that gives you a long jump on competition**

The right wire CAN do it, sometimes, by improving your product — or reducing your costs — or speeding up production. And Keystone's technical men have helped many manufacturers find the right wire for their purpose. Each wire user represents an individual problem to us. We'd like to have *you* for a problem, and if we can't help you, there's nothing lost. So why not put it up to us?

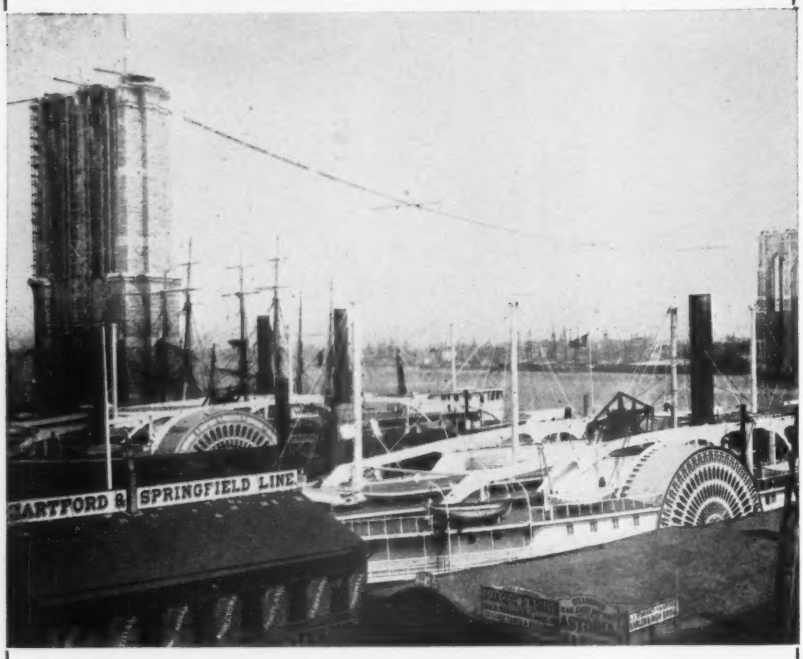
SAMSON SPRING WIRE — REG. U.S. PAT. OFF. — KEYSTONE STEEL & WIRE CO. PEORIA, ILL.

HIGH CARBON or LOW CARBON

Bright... Tinned Coppered Annealed Galvanized

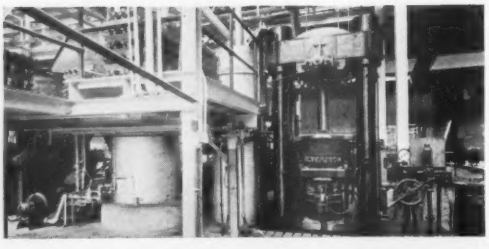
KEYSTONE

STEEL & WIRE CO., Dept. W, PEORIA, ILL.



1870 The First Cable over the Brooklyn Bridge

•John A. Roebling's Sons Company erected the cables for New York's Brooklyn Bridge with the aid of Robertson Equipment. And, Robertson Equipment for many years has been used by Roebling for lead encasing electrical wires and cables.



• Robertson makes all types of lead-encasing machinery including Extrusion Presses, Hydraulic Pumps, Melting Furnaces and Pots, Dies and Cores, also Lead-Sheath Stripping Machines and Hydro-pneumatic Accumulators.

Bulletins giving complete description are yours without obligation.

JOHN ROBERTSON CO., INC.
125-137 Water St., Brooklyn, N. Y.

Exports and Imports of Wire

(*Continued from Page 123*)

gross valued at $851; Colombia 5,328 gross valued at $766; Salvador 3,132 gross valued at $358; Mexico 2,517 gross valued at $441; United Kingdom 2,190 gross valued at $327; Argentina 2,163 gross valued at $1,593; Panama 1,529 gross valued at $219; Canada 941 gross valued at $122.

✦ ✦ ✦

EXPORTS of brass wood screws during the same month totaled 7,756 gross valued at $3,432. Of this total Colombia supplied 3,864 gross valued at $2,060; Cuba 1,550 gross valued at $352; Peru 710 gross valued at $200; Costa Rica 425 gross valued at $226; Venezuela 286 gross valued at $80.

✦ ✦ ✦

IMPORTS of wood screws during the same month totaled 30,230 gross valued at $2,223. Of this total Belgium supplied 21,230 gross valued at $1,851 and Japan 9,000 gross valued at $372.

✦ ✦ ✦

Micromax Condensate Purity Instruments

A NEW 20-page, illustrated catalog on "Micromax Condensate Purity Instruments for the Steam Plant" is offered to executives, engineers and operating men concerned with steam generation . . . whether for power or process use. It shows how a knowledge of condensate conditions helps to effect important operating economies. It describes a reliable electrical method for continuously determining variations in condensate purity. It also describes Micromax recorders which automatically draw a chart record of condensate conditions, and, if contamination occurs, actuate an alarm to warn operator, or in addition, operate a motorized valve to divert impure condensate to waste. Illustrations include typical applications. To receive a copy, ask Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia, for Catalog N-95-163.

A Review of Recent Wire Patents

No. 2,139,011, APPARATUS FOR PRODUCING STEEL CABLES, Patented December 6, 1938 by William H. Furness, Riverton, N. J., assignor to American Rayon Company, Inc., Riverton, N. J., a corporation of New Jersey.

This apparatus is said to be provided for producing cables having flexibility from the central portion outwardly, substantially free of "windup" and whip and especially adapted for the front wheel drive mechanism of automobiles.

✦ ✦ ✦

No. 2,139,051, MANUFACTURE OF ELECTRIC CABLES, Patented December 6, 1938 by Russell Swale Vincent, London, England, assignor to Callender's Cable and Construction Company, Limited, London, England, a British company.

The claims of this patent are drawn to a method of producing an impregnating compound for cables, including the use of a colloidal solution of pure rubber in mineral oil exposed to high vacuum at an elevated temperature.

✦ ✦ ✦

No. 2,139,380, COMBINATION ENDLESS CONVEYER BELT AND GRADER SCREEN, Patented December 6, 1938 by Nelson Howard Norris, Bath, N. Y., assignor to Ethel E. Norris, Bath, N. Y.

Ends of the interconnected longitudinal links of the wire belt are individually held against lateral movement.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 17 East 42nd St., New York.

No. 2,139,495, WIRE FABRIC BELT STRUCTURE, Patented December 6, 1938 by Raymond J. Guba, Philadelphia, Pa., assignor to Audubon Wire Cloth Corporation, Philadelphia, Pa., a corporation of New Jersey.

Chain-like reinforcing means at the marginal edges of the wire belt is provided, with pairs of the belt wires being permanently connected at their ends.

✦ ✦ ✦

No. 2,139,936, MACHINE FOR MAKING BOLTS, Patented December 13, 1938 by William L. Clouse, Tiffin, Ohio, assignor to The National Machinery Company, Tiffin, Ohio, a corporation of Ohio.

It is said that a new shear arrangement is provided, among other improvements, and a different distribution of weight of parts. There are 42 claims.

✦ ✦ ✦

No. 2,140,169, WIRE-SEVERING MECHANISM, Patented December 13, 1938 by Alfred L. Rosenmund, Rockaway, N. J., assignor to Stapling Machines Co., a corporation of Delaware.

This mechanism is described as adapted for use with the machine set out in U. S. patent No. 1,933,031 of October 31, 1933, and is adapted to cut cleanly very flexible or "soft" wire as well as stiffer wire.

✦ ✦ ✦

No. 2,140,237, WELDING WIRE FOR CARBON ELECTRODE ARC WELDING, Patented December 13, 1938 by Franz Leitner, Kapfenberg, Steiermark, Austria.

The wire contains up to 0.45% carbon, 0.25 to 1% silicon, 0.20 to 3% manganese, not more than 0.06% sulphur, not more than 0.045% phosphorus, at least one metal selected from the group consisting of up to 1.2% zirconium, up to 0.50% aluminum, up to 0.80% titanium, up to 0.40% vanadium, up to 1.50% tantalum and up to 0.30% magnesium, and the remainder iron.

✦ ✦ ✦

No. 2,140,238, WELDING WIRE FOR ELECTRIC ARC WELDING, Patented December 13, 1938 by Franz Leitner, Kapfenberg, Steiermark, Austria.

In this wire there is a ferrous electrode containing at least one metal selected from the group consisting of 0.05 to 0.7% aluminum and 0.1 to 1.5% titanium and having a core containing 80 to 95% lime and 20 to 5% aluminum.

✦ ✦ ✦

No. 2,140,270, ELECTRIC CABLE, Patented December 13, 1938 by Frank M. Potter, Rome, N. Y., assignor to Gen-

(Please turn to Page 126)

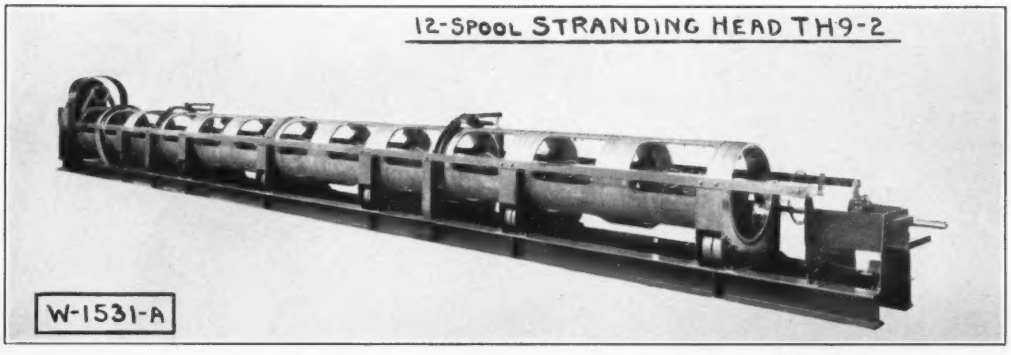
THE WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON, NEW JERSEY, U. S. A.

TUBULAR STRANDING MACHINES

Standard Sizes For From 5 to 1000 Pound Spools
Silent Support Rolls—All Steel Rotor—Vee Belt Drive—Electric Stops



ELECTRICAL WIRE, CABLE & WIRE ROPE MACHINERY

Printed Literature Available On Considerable Of The Equipment Used In These Fields—Inquiries Are Invited

(Continued from Page 125)

eral Cable Corporation, New York, N. Y., a corporation of N. J.

To prevent nicks, formed by the metallic armor of the cable, upon the conductor, the inventor provides a protective separation between the two, such as paper.

✦ ✦ ✦

No. 2,140,449, SCREW WITH SOCKETED HEAD AND PLURALITY OF SLOTS, Patented December 13, 1938 by Frank K. Brown, South Dartmouth, Mass., assignor to Continental Screw Company, New Bedford, Mass., a corporation of Mass.

The head is provided with slots for a common screw-driver or a winged driving tool, and has a conical recess to act as a tool holding or wedging portion.

✦ ✦ ✦

No. 2,140,488, APPARATUS FOR MAKING WIRE MESH, Patented December 13, 1938 by Herbert E. White, San Francisco, Calif., assignor to E. H. Edwards Company, a corporation of California.

There are 33 claims in this patent to an apparatus for producing open mesh wire fabric of crossed strands which are in continuous lengths.

✦ ✦ ✦

No. 2,140,501, RUSTLESS IRON, Patented December 20, 1938 by William Bell Arness, Baltimore, Md., assignor, by mesne assignments, to Rustless Iron and Steel Corporation, Baltimore, Md., a corporation of Delaware.

The iron is said to be adapted for use in rods and wires, and includes: about 10 to 25% chromium, 7 to 20% nickel, .08 to .15% sulphur, .03 to .12% carbon and balance all iron hardened by cold reduction to a Brinell number of between 180 and 250.

✦ ✦ ✦

No. 2,140,535, APPARATUS FOR CONVERTING CONTINUOUS FILAMENTS INTO PRODUCTS CONTAINING STAPLE FIBERS, Patented December 20, 1938 by Alexander McGill and Harry Taylor, Spondon, near Derby, England, assignors to Celanese Corporation of America, a corporation of Delaware.

By bending and stretching the strapping, while under tension, it is stated that this apparatus will remove camber.

✦ ✦ ✦

No. 2,140,544, LEAD-BISMUTH-LITHIUM CABLE SHEATH, Patented December 20, 1938 by Hans Osborg, Bronxville, N. Y., assignor to Maywood Chemical Works, Maywood, N. J., a corporation of N. J.

To the lead, this inventor adds lithium to the extent of between 0.005 to 0.025% (with bismuth between 0.03 to 0.09%).

✦ ✦ ✦

No. 2,141,290, ELECTRIC CABLE, Patented December 27, 1938 by George Carlson, Bridgeport, and Homer G. Knoderer, Fairfield, Connecticut, assignors to General Electric Company, a corporation of N. Y.

The assembly comprises a tape of fibrous material over the insulation-covered conductors, a layer of asphalt pitch over the tape, another tape of fibrous material, a spirally wound conductor over the tape, armor, and a braid over the armor.

✦ ✦ ✦

No. 2,141,395, WINDING APPARATUS, Patented December 27, 1938 by Fred V. Johnson and Duer C. Robson, Baltimore, Md., assignors to Western Electric Company, Incorporated, New York, N. Y., a corporation of N. Y.

A take-up device is provided for wire strand winding machinery, dispensing with the use of a guide member for constraining the longitudinally advancing strand to move laterally.

✦ ✦ ✦

No. 2,141,588, SPRING KNOTTING MACHINE, Patented December 27, 1938 by Fred R. Zimmerman, Chicago, Ill., assignor to Nachman Springfilled Corporation, Chicago, Ill., a corporation of Illinois.

Adapted for knotting the wires comprising upholstery springs, this machine bends the wires and knots them almost simultaneously.

✦ ✦ ✦

No. 2,141,661, WIRE TWISTING APPARATUS, Patented December 27, 1938 by Dan O'Neil, Aliquippa, Pa., assignor to Jones & Laughlin Steel Corporation, Pittsburgh, Pa., a corporation of Pennsylvania.

The apparatus twists square wire for nail making.

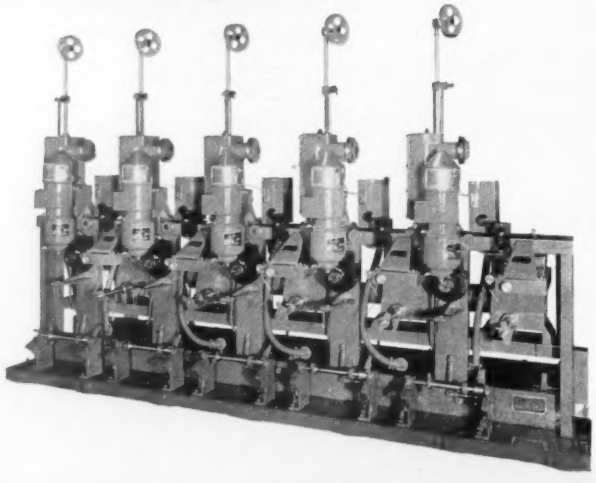
✦ ✦ ✦

No. 2,141,706, WIRE FABRIC JOINT AND METHOD OF PRODUCING SAME, Patented December 27, 1938 by

Important advantages of . . . . .
Syncro Fine Wire Serving Machines.

(Serving No. 19 to No. 35 B&S Gauge Wire)

FIVE or more independently operated Spindles can be mounted on one frame. . . Each flyer is directly motor driven and can be operated separately at 3400, 5200 or 7000 R. P. M. . . Every flyer is equipped with a cop tension control and arranged for automatic stop. . . Spools ranging from 5 lbs. to 50 lbs. can be accommodated by the Take-up units. . . Each Take-up is individually driven by a torque motor providing a wide range of tensions. . . A screw type distributor with a finely adjustable pitch and stroke driven from the take-up, provides for exceptionally accurate spooling. . . Write for Bulletin No. 420.



SYNCRO

SYNCRO . MACHINE . COMPANY

420 Lexington Avenue New York

William E. Buchanan, Appleton, Wis., assignor to Appleton Wire Works, Inc., Appleton, Wis., a corporation of Wisconsin.

Fourdrinier wire fabric is produced, it is said, soldered or brazed at joints, with the mesh openings substantially free from transverse obstructions.

✦ ✦ ✦

No. 2,141,910, ELECTRIC CABLE, Patented December 27, 1938 by William C. Hayman, Schenectady, N. Y., assignor to General Electric Company, a corporation of N. Y.

The cable is especially adapted for use in secondary underground network systems at low voltage on heavy currents and the invention lies in a new insulation material.

✦ ✦ ✦

No. 2,141,934, BELT DRIVEN WIRE SPOOLER, Patented December 27, 1938 by William D. Pierson, Waterbury, Conn., assignor to The Waterbury Farrel Foundry & Machine Company, Waterbury, Conn., a corporation of Connecticut.

The winding spool is detachably journaled on a fixed horizontal axis and is driven by a vertical endless belt running over a pair of pulleys mounted on horizontal axes, one of the pulleys being power driven and mounted on a fixed shaft, while the other pulley is idle and mounted on a swinging cradle pivoted to the fixed shaft.

✦ ✦ ✦

Australia to Have Abrasive Plant

RAPID expansion of the metal working industry in Australia in the past few years has caused Australian industrialists, supported by the keen interest of the Australian government, to seek basic industries to round out their program. Agricultural implement plants have been expanded and a new one is in the course of construction. Steel plants, motor car assembly units and similar enterprises have contributed to this rapid industrial development.

✦ ✦ ✦

BECAUSE of the dependence of modern metal working industry on efficient abrasive products, Australian interests sought the cooperation of American and British grinding wheel manufacturers in forming an Australian company to produce grinding wheels and allied abrasive and refractory products.

✦ ✦ ✦

THE new plant of Australian Abrasives Pty. Limited, will be located on a four acre tract in the industrial district of Sydney, New South Wales. Construction will begin in about one month. Interested in the new company are the following: Carborundum Company, Niagara Falls, New York, Norton Company, Worcester, Massachusetts, Universal Grinding Wheel Company, Limited, Stafford, England, and William McPherson of McPherson's Pty. Limited, Australia.

✦ ✦ ✦

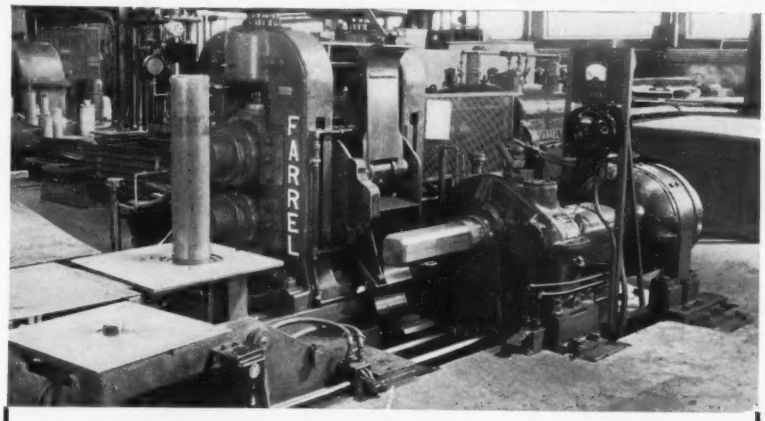
Whitney-Blake Appoints Noma Electric Corporation

THE Whitney Blake Company of New Haven has made permanent arrangements with the Noma Electric Corporation of New York City to furnish that company with all manufacturing requirements of wire, as well as a complete line of cord sets and wires, which will be distributed by Noma Electric through its jobbers.

✦ ✦ ✦

L. J. Galbreath

THE appointment has been announced of Louis J. Galbreath, as Technical Advisor for the New York District Sales Division of Revere Brass and Copper, Inc.



FARREL CONSTANT TENSION REELS

Improve Strip Quality
Increase Mill Output
Reduce Rolling Cost

In the cold rolling of metal strip efficient winding of the finished strip is an important factor in the quality of material, rate of output and production cost.

The Farrel Tension Reel with Jaw Type Wrapper, Stripper and Up-Ender illustrated above is one of several types of reeling equipment we make to facilitate winding and subsequent handling. It provides constant tension under positive control from empty to full reel, keeping the metal flat and straight and maintaining uniform gauge.

The reel drive is an enclosed herringbone gear reduction unit with the low speed shaft extended in the form of a spindle on which either a solid or collapsible reel is rotated for winding the strip. Close control of tension is accomplished by automatic regulation of current input to the motor. All controls are conveniently located within easy reach of the operator.

The recent installations of thirty-three Farrel Constant Tension Reels in eight plants, with a high percentage of these repeat orders, is the best indication of their successful operation.

We make various types of reels designed to fit specific requirements and shall be glad to tell you how they can be applied to your rolling mills to give you the advantages of improved quality, increased output and lower cost.

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ANSONIA, CONN.
New York • Buffalo • Pittsburgh • Akron • Chicago • Los Angeles

'Round the World With the Wire Industry

German Notes

THE German wire industry has been working at 92% of the capacity in November, compared with 88% same time last year. The maximum capacity is probably 95% of the full capacity. The raw material supply is satisfactory. The German wire rod production in October was 130,000 tons which is approximately 28,000 tons more than same time last year.

✦ ✦ ✦

ON the wire export market the situation is unchanged, the demand being still satisfactory, in spite of a certain decline of total bookings during December. Wire netting and wire nails were best demanded of all wire products, whereas barbed wire and fencing wire were less in demand. No change of prices is to be reported. With very few exceptions prices are the same as last month. The international wire rod cartel has left the export prices unaltered, which is about £ 5.2.6. to 5.7.6. (gold) to the markets. The demand is satisfactory. The Balkans, the Baltic States, Scandinavia and Japan are buying fairly well. American competition in certain wire products is reviving, particularly as concerns the business in wire nails in the Far East and fencing wire in South Africa and Central America. On the South American markets the agreement with Europe is working very well.

✦ ✦ ✦

THE wire machinery export trade is very active. The demand for almost all machines, except for wire nail machinery is rather satisfactory. Shipment times are still between 4 and 6 months for export and 8-10 months to domestic buyers.

Bell-Mine Pulverized Lime for Wire Drawing

has assured uniformity and purity because the pure limestone is deep-mined 700 feet below surface at Bellefonte; is burned in large modern Rotary Kilns under constant engineering supervision; and the lime is check-tested by trained chemists in Warner Laboratories at the plants.

Warner Company
BELLEFONTE DIVISION

SALES OFFICES: PITTSBURGH, PHILADELPHIA, BELLEFONTE, N. Y. CITY

THE cable export trade is very satisfactory, fresh business flowing in at a high rate. During the first 10 months of 1938 German cable export has advanced by 22% over last year, which was already 27% better than the year before.

✦ ✦ ✦

REPORTS have been circulating concerning an agreement with the Japanese industry for the export markets in the Far East following the establishment of a Japanese Central Body for export. The reports are however too early, although negotiations have indeed been pending for some time. Japan is at present no keen competitor in all free markets but is reserving her export trade for Mandschukuo and China.

✦ ✦ ✦

POLAND is constructing a new industrial center (near Sandomir) and the recently granted large commercial credits by Germany include also considerable amounts of industrial machinery among which is wire machinery to the value of approximately one million dollars, including equipment for wire works. These machines will be bought in one year and be delivered latest in Spring, 1940.

✦ ✦ ✦

RUSSIA is inquiring at present for large quantities of paper making wire and wire mesh (fourdrinier and card clothing and other). The scarcity of paper in Russia is said to be partially due to the lack of wire mesh.

✦ ✦ ✦

THE improvement on the wire export market is fully maintained. The Near East has been favorably influenced by the circumstance of Italy's remaining a member of the IWECO. The Oderberg works of the Berg & Huttenwerkegesellschaft belongs now to Poland, but, although Poland is no longer a member of the IWECO, these works which were the main exporters of wire products

in Czechoslovakia (before the territory went to Poland), will sell further through the IWECO, which means about 8,000 tons annually. The sales for export of the IWECO were about 138,000 tons in August, September, October, whereas only 131,000 tons had been sold for export during the first seven months of this year. This shows a very satisfactory improvement. November sales have reached approximately 50,000 tons. In Hamburg export quarters it is hoped this improvement will last up to the beginning of 1939. The circumstance that it was possible to come to an amicable agreement with the American industry regarding the Latin American and Far Eastern markets (prices for a number of products) has also been particularly welcomed, as the price cutting has disappeared for most products. As a consequence prices have been increased. The average increase for wire nails was s 5, barbed wire s 2/6, galvanized wire s 7/6 to s 10/, bright and annealed wires s 7/6, strand wire s 12/6 per ton and a further increase is possible. The quotations for wire netting have been advanced by 7-9%. The demand for wire netting has also improved and the export turnovers were increased by approximately 20% since summer months.

✦ ✦ ✦

THE wire rope export business has not participated in the general improvement of the wire market as much as all other products. Though the domestic market is very satisfactory, the export demand is calm. Business in ropes with hemp core has particularly suffered. The better qualities however are in good demand and the average revenues of rope exports have improved since last year to the extent of 18%, although prices are more or less unchanged, due to the circumstance of the export markets demanding much better grades of ropes.

✦ ✦ ✦

THE wire machinery business with Europe continues satisfactory, but is not as good with Oversea. Wire nail machinery is in less demand, as such industries are not expanding production.

GOING TO PRESS

MARCH 1st, 1939

THE 1939 EDITION

of the

WIRE

& WIRE PRODUCTS'

— Buyers Guide —

and Year Book

of the

WIRE ASSOCIATION

The only reference book available listing all components of the wire industry, completely indexed.

Invaluable to purchasers of rod, strip, bare and covered wire and cable, cold drawn bars and cold headed products.

Gives sources of machinery, materials and equipment for manufacturers of rod, strip, wire and wire products.

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For $25.00 you can have as many bold face listings as you desire and five one-inch advertisements under or facing the headings you select. Full information will be supplied on request.

WRITE AT ONCE FOR FULL DETAILS

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17 East 42nd Street New York, N. Y.

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

Why the Master Mechanic likes Duriron Equipment:

Because it gives him an "ace in the hole"

Sudden switches from one acid to another doesn't cause him a flutter: for instance, a change from sulfuric acid to hot nitric acid. He just says, "Go ahead with it, boys—that's Duriron—'twon't hurt it a bit".

Or if he has a Duriron pump standing idle in one department. In emergencies, he can yank it out and put it to work in another department to handle other corrosives.

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For times when you have to deal from the bottom of the deck, equip with Duriron. Then no one can call your hand and put you in the hole.

Write for bulletins on acid-handling equipment

THE DURIRON COMPANY, Inc.

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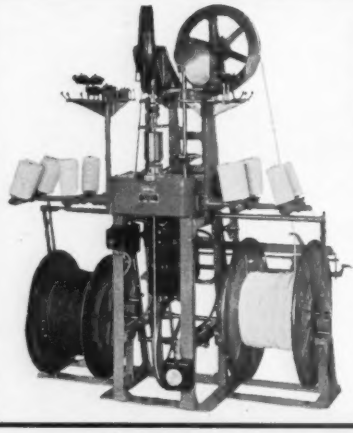

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Single and Triple Covering Models
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STEEL WIRE

By MAURICE BONZEL

Translated and Published by Kenneth B. Lewis, Consulting Engineer

Price $15.00

495 pages. 414 charts, photomicrographs and illustrations

SEND ORDERS TO

WIRE and WIRE PRODUCTS

17 E. 42nd STREET, NEW YORK

Some Aspects of the Patenting Process

(*Continued from Page 106*)

TODAY the use of oil-fired, gas-fired, and electric furnaces has resulted in a far closer control of the patenting process than was ever considered possible in the past. We ourselves have adopted city gas-fired furnaces and Figure 11 shows a general view of one of our latest furnaces. The cabinet shown near the entrance end of the furnace contains a Leeds and Northrup Two Point Temperature Recorder with automatic control equipment, and also an autographic gas flow recorder.

✦ ✦ ✦

ACCURATE methods of quenching in molten lead or salts have enabled the patented microstructure and the tensile strength of the patented base wire to be controlled within narrow limits. This has undoubtedly facilitated the production of patented steel wires, and it is possible now to meet without trouble, specifications which in the old days were regarded with considerable apprehension, and which gave rise to bulk rejections.

✦ ✦ ✦

General Cable Corp. to Dispose Of Four Plants

THE General Cable Corporation is offering for sale four manufacturing properties which it no longer requires as its capacity at the new plants are sufficient to meet current and future requirements that are now apparent. The properties are located at Pittsburgh, Detroit, Fort Wayne and Harrison. Information about the plants can be obtained from the home office, 420 Lexington Avenue, New York City.

This is an invitation for you to become a member of The Wire Association. ✦ ✦ ✦ ✦ ✦ ✦

The Annual Dues are $10.00

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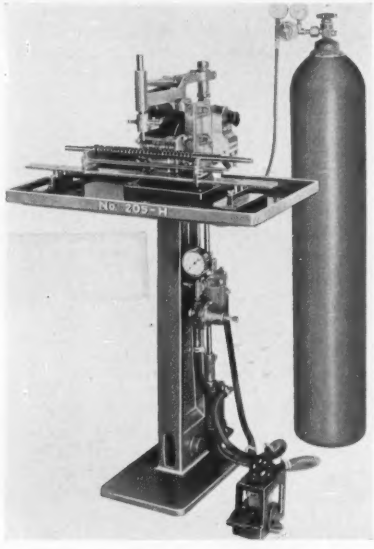
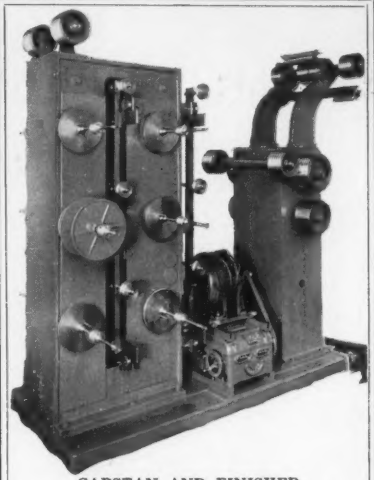
ELECTRIC spot welding machine equipped with automatic hydrogen gas economizer. This type of equipment is employed for welding molybdenum, nickel or other similar metals. In order to prevent oxidation, hydrogen gas is introduced at the time of welding. The flow of hydrogen is directed directly to the spot where the welding takes place.



THE automatic gas economizer and shut-off valve are so arranged that immediately after the weld is completed the gas is cut out and this gas burns at the spot only during the actual welding operation. When the welding tips make contact with the work and a weld is made, the valve permits a small amount of gas while flaming right over the spot of the weld, only during welding time. This prevents oxidation, and also very often it prevents the material from becoming brittle, which is the case where fine molybdenum wires are welded to heavy side wire guides for large electronics tubes and similar metals. This particular machine is an air operated vertical plunger type model and the capacity of the machine is 5 KVA. These same machines are made up to sizes of 250 KVA.

✦ ✦ ✦

THESE machines are produced by Eisler Engineering Co., Inc., 750 So. 13th Street, Newark, New Jersey.



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FOR THE

WIRE AND CABLE INDUSTRY

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CHICAGO, ILL.

Wire Association Questions And Answers

(Continued from Page 121)

Answer No. 2

"BOXES made of sulphite pulp will cause rust if moisture is also present, but not if the articles are dry. If there is a variation in temperature so that moisture condenses on the pins, they will rust whether the boxes are acid reaction or not."

✦ ✦ ✦

Answer No. 3

"IT is a difficult matter to give a reliable statement or answer to this question, but it is safe to assume that there is chance for corrosion where metal parts are packed in cardboard containers for we assume that when the merchandise is packed in these containers that it would be stored in a room with a dry atmosphere.

We know that many manufacturers are very careful about the cardboard used in containers and we believe it would be wise for your customer to look into this feature of their trouble; furthermore to see that the merchandise in question is packed in oiled paper or cellophane." ✦ ✦ ✦

Question No. 4234

Straightening Fine Flat Wire

To The Wire Association:

"On page 98 of the February issue reference is made to an electric tensiometer for indicating and controlling strip tension. We would be glad to have further information regarding this instrument, particularly with reference to a fine strip such as the sample enclosed.

Our immediate problem seems to be in straightening this flat wire which may not be a question of tension and we would be glad to have any information regarding this particular problem which you or someone else in your organization may be able to give us or advise us as to where we may obtain help in solving this problem."

✦ ✦ ✦

Answer No. 1

"WE doubt very much if the tension would make this wire crooked. If the unevenness is edgewise, this would be caused in the rolling by not having the face of the rolls parallel and is called poor rolling. However, if it is crooked in the flat plane, this might be caused in handling or shipping.

To straighten in the latter case, we would suggest a properly designed seven roll straightener and it might be possible to take out some of the unevenness edgewise by having another set of seven rolls at right angles to the first set. This is commonly known as a two plane, seven roll straightener.

You do not state if this material is cut to length after straightening, but if this was the case, a two plane straightener could be applied back to the feed rolls or to any type of automatic feeding or forming machine."

✦ ✦ ✦

Answer No. 2

"IN connection with your recent inquiry you will be interested in the attached bulletin GEA-2428, prepared by Mr. F. Mohler of the General Electric Company, and describing how tensiometers

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✦ ✦ ✦

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✦ ✦ ✦

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Box 112

Wire & Wire Products

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NEW YORK, N. Y.

are used for rolling cold strip steel.

If you are interested in rolling a very narrow and thin strip as per the sample attached to your letter, a somewhat different tensiometer can be readily built, based of course on the same principle but much smaller in size. Definite recommendations could be prepared by us if we know fully your problem."

Question 4252

Colored Stitching Wire

Can you advise us where colored stitching wire is procurable. The wire appears as though the color is impregnated in the metal. Can you also tell us what process is used to obtain this result?

✦ ✦ ✦

Answer No. 1

"THE Chromium Corporation of America has a patented process for anodic deposit of copper oxide by which you can get almost any color of the spectrum.

They license companies to use this process for their own production. I can see no reason why it could not be applied to strand wire colorings."

✦ ✦ ✦

Answer No. 2

"WE have never heard of box binding or stapling, or even fine stitching wire being put up in different colors, and we are wondering whether this party's informant was not misled by possibly the sight of some coppered stitching wire. As you no doubt know, flat coppered stitching wire, as well as flattened galvanized wire is used for stapling fiber cartons. We have never heard of any color other than galvanized or annealed used for the ordinary wire bound box or crate."

✦ ✦ ✦

Answer No. 3

"SOME of this material is furnished with a copper finish, and it is likely that in the various processes somewhat of a dark brown bronze finish may have been worked out. We have never heard of a painted wire although there is an enameled wire and a red enamel, in our opinion, can be applied just as well as black."

✦ ✦ ✦

Answer No. 4

"PLEASE be advised that we believe the American Steel and Wire Company is in a position to paint wire in coils. We further believe that they are the only manufacturer who have entered this field."

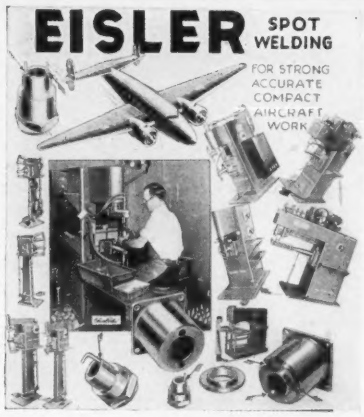
✦ ✦ ✦

Answer No. 5

"RECENTLY I have heard of different colors or tints being placed on box binding and stapling wire, that I assume is merely some simple lacquer that will adhere to the finished wire when passed through the lacquer continuously. I suppose the lacquer should be heated to, I would guess, 160 degrees, and then allowed to dry just previously to being wound up on the take-up frame.

It is suggested that for the different colored lacquers the Du Pont people be approached, or some paint company, the name of which I have forgotten. It is further suggested that you contact the 4-One Machine Manufacturers at Rockaway, New Jersey."

(Please turn to Page 135)



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New Building Materials Research At Mellon Institute

DR. EDWARD R. WEIDLEIN, Director, Mellon Institute, Pittsburgh, has announced the establishment of an Industrial Fellowship in that institution by the United States Gypsum Co., of Chicago, Ill. This Fellowship will conduct fundamental research on various products manufactured by the donor company, with the objective of developing new processes and technics which will have broad application in the field of building materials. This investigational work will augment the regular research activities carried on by the donor.

✦ ✦ ✦

DR. H. E. SIMPSON, who has been appointed to the incumbency of the Fellowship, has been a member of Mellon Institute since 1936. He received his professional education at the Ohio State University (B. Cer. E., 1925; M. S., 1926; Ph.D., 1929). He served as assistant professor in the ceramic department at Rutgers University in 1930 and during the period 1930-36 was research engineer for the Battelle Memorial Institute, Columbus, Ohio. Since then Dr. Simpson has been on the staff of the Multiple Fellowship on glass technology in Mellon Institute.

✦ ✦ ✦

Rockwell Appoints Firmin & Keown

W. S. ROCKWELL COMPANY announce the appointment of Firmin & Keown, Commonwealth Bldg. Annex, Pittsburgh, Pa. as their representatives in the Western Pennsylvania district. This appointment under the supervision of Mr. B. C. Firmin, is another step forward by the W. S. Rockwell Company in their efforts to provide users of Industrial Heating Furnaces with the advantage of their 50 years of experience.

The date of the Annual Wire Association Convention for 1939 has been changed from October 16th to October 23rd to 27th inclusive.

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STEEL STEVENS REELS
FOR
WIRE AND CABLE INDUSTRY
STEVENS METAL PRODUCTS CO.
NILES, OHIO.

Wire Association Questions and Answers

(Continued from Page 133)

Answer No. 6

"I BELIEVE there is a concern somewhere in New Jersey that manufactures box and stitching colored wire, but they coat it with some kind of paint and made in a process similar to galvanizing and baked.

I have drawn some wire using red lead as a lubricant and this will leave the finished wire with a red coating.

I would suggest if the company would do a little experimenting that they should clean the rod in the usual way, and instead of using lime, dip in a light solution of red lead, and if necessary later coat with lime, rod to be baked thoroughly dry.

Mix lubricant for drawing with red lead and oil and keep in form of paste; if necessary add enough lime to make it thick."

✦ ✦ ✦

Answer No. 7

"WE supply what we call Colorstitch used as a Stapling Wire to stitch fancy boxes and blend or contrast color schemes. This is done by a special process and has been offered to the trade for some months. It seems to be gaining favor, and so that your client may see just what we are offering I enclose a sample card showing stitches with color numbers."

The Wire Association is for the specific purpose of improving production methods. It is organized as a clearing house of ideas on technical problems and research work in all phases of practical wire drawing and wire working.

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8—Shuster Automatic S. & C. Machines 1/32", 1/8", 3/16", 1/4", 3/8", 1/2", also 1/2", 3/8" square wire, motor driven.
Wanted: Wire Spring making machinery.

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Combination Cable Armoring Machine

THE new Cable Armoring Machine, designed by **Sleeper & Hartley, Inc.**, Worcester, Mass., is a combination of five separate units which function as follows:

✦ ✦ ✦

THE **strander, or take-off,** consists of a rotating head, carrying two or three trunions upon each of which is suspended a 30" spool of insulated conductor wire. The head rotates, twisting the several wires together, but the spools stay in a normally horizontal plane. A friction device provides control of wire tension.

AS the twisted wires proceed, through the head, they enter a wrapping device whereby the twisted wires are wrapped with a continuous paper strip. The paper-wrapped twisted wires then pass to and through the **armoring head** which coils around them a galvanized steel strip. The strip stock is supplied from a split spool, which, when empty, may be removed from the head, over the finished cable, without necessity of cutting.

✦ ✦ ✦

THE **spooler,** the next unit in line, has a hollow spool spindle with rotating head and quick-release jaws. It is equipped with a double-screw traverse mechanism which properly lays the desired width of strip stock. Full spools are shifted from the Spooler to the Armoring Head by means of chain-fall on overhead rail.

✦ ✦ ✦

THE finished cable then reaches the measuring and **cut-off** unit consisting of flexing rolls (horizontal and vertical) a draw-out capstan which keeps the cable taut from the Armoring Head, through the hollow spindle of the spooler and around both flexing rolls. The Measuring Wheel is so arranged that the finished cable rides over the surface thus causing movement of a trip cam connected to the cutting device and is arranged with change gears for cuts of 100, 150, 200, 250 foot lengths. The cutting-saw operates automatically while the Cable Armoring Machine is in operation.

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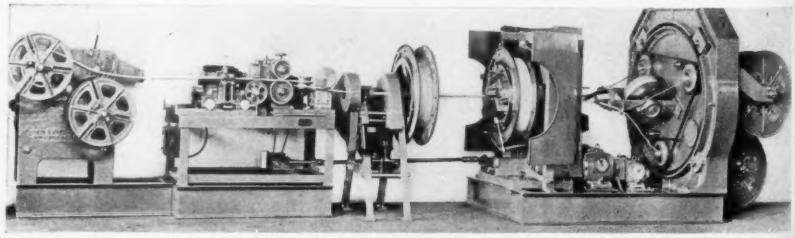
THE **take-up,** a 2-spindle unit, is equipped with 20"x6"x10" barrel collapsible spools with removable front flanges and each spindle is equipped with an individual clutch for independent operation. A friction device assures constant speed of the **take-up.** A cam-operated traverse device with change gears is provided to cover complete range of cable diameters.

✦ ✦ ✦

THIS new Cable Armoring Machine, approximately 24 feet long, was developed to meet the demand of armored cable manufacturers for a machine that would run for long periods requiring minimum labor of tooling and handling.



Take-Up — Cut-Off — Spooler — Head — Strander

Combination Cable Armoring Machine
Patent Applied For

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Watson Machine Co., Paterson, N. J.

BAKERS—Rod and Wire
Morgan Construction Co., Worcester, Mass.
Morrison Engineering Co., Cleveland, O.

BOBBINS—Braider and Wire Weaving
Mossberg Pressed Steel Corp., Attleboro, Mass.

BORON CARBIDE—
Norton Co., Worcester, Mass.

CARRIERS—Braider, High Speed
Mossberg Pressed Steel Corp., Attleboro, Mass.

CEMENT FLOOR CLEANER—
Magnus Chemical Co., Garwood, N. J.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Magnus Chemical Co., Garwood, N. J.

CLEANERS—Hand and Metal
Magnus Chemical Co., Garwood, N. J.

CLEANING & PICKLING EQUIPMENT—
Broden Construction Co., Cleveland, O.
Duriron Co., The, Dayton, O.
Haveg Corp., Newark, Del.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

COATING—Protective
American Lanolin Corp., Lawrence, Mass.

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

CONDUITS—Iron and Steel
Youngstown Sheet & Tube Co., Youngstown, Ohio.

CONTROLS—Automatic
Leeds & Northrup Co., Philadelphia, Pa.

COPHOLDERS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

CRANES—Wire Mill
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

DIAMOND TOOLS—
Rusch Wire Die Corp., New York, N. Y.

DIES—Diamond
Cochaud Wire Die Co., New York, N. Y.
Driver-Harris Co., Harrison, N. J.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Co., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Willeys Carbide Tool Co., Detroit, Mich.

DIES—Rod and Tube Drawing
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Willeys Carbide Tool Co., Detroit, Mich.

DIES—Tantalum Carbide
Carboloy Co., Inc., Detroit, Mich.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tungsten Carbide
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DRAW BENCHES—
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O

DRUMS—Flange Steel
Stevens Metal Products Co., Niles, O.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

ENGINEERS—Consulting Wire Mill
Hartley, George D., Worcester, Mass.
Lewis, Kenneth B., New York, N. Y.

EQUIPMENT—Insulation Testing
Leeds & Northrup Co., Philadelphia, Pa.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FILLERS—Paper for Cable
E. W. Twitchell, Inc., Phila., Pa.

FLASH BAKERS—
Morrison Engineering Co., Cleveland, O.

FURNACE CONTROLS — Combustion and Draft
Leeds & Northrup Co., Philadelphia, Pa.

FURNACES—Annealing
Electric Furnace Co., Salem, O.
Leeds & Northrup Co., Philadelphia, Pa.
Mahr Manufacturing Co., Minneapolis, Minn.

FURNACES—Automatic
Electric Furnace Co., Salem, O.
Leeds & Northrup Co., Philadelphia, Pa.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.
Mahr Manufacturing Co., Minneapolis, Minn.

FURNACES—Electric
Electric Furnace Co., Salem, O.

FURNACES—Hardening and Tempering
Electric Furnace Co., Salem, O.
Leeds & Northrup Co., Philadelphia, Pa.
Mahr Manufacturing Co., Minneapolis, Minn.

FURNACES—Lead Melting
Electric Furnace Co., Salem, O.
John Robertson Co., Brooklyn, N. Y.

FURNACES—Non-Oxidizing
Electric Furnace Co., Salem, O.
Mahr Manufacturing Co., Minneapolis, Minn.

FURNACES—Normalizing
Electric Furnace Co., Salem, O.
Leeds & Northrup Co., Philadelphia, Pa.

FURNACES—Salt Bath
Electric Furnace Co., Salem, O.

FURNACES—Wire, Strip & Sheet
Electric Furnace Co., Salem, O.
Mahr Manufacturing Co., Minneapolis, Minn.

GEARS—Wire Mill
Farrel-Birmingham Co., Ansonia, Conn.

GENERATORS—Nitrogen
Mahr Manufacturing Co., Minneapolis, Minn.

GRINDERS—ROLL
Farrel-Birmingham Co., Ansonia, Conn.
Norton Co., Worcester, Mass.

INHIBITORS—
American Chemical Paint Co., Ambler, Pa.

INSTRUMENTS—Electrical
Leeds & Northrup Co., Philadelphia, Pa.

INSULATION — Cable or Cable Filler
E. W. Twitchell, Inc., Phila., Pa.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LEAD—Pig
St. Joseph Lead Co., Josephtown, Beaver County, Pa.

LIME—Pulverized
Warner Co., Bellefonte, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Magnus Chemical Co., Garwood, N. J.

LUBRICANTS—Wire Drawing
Magnus Chemical Co., Garwood, N. J.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Bunching
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

MACHINERY—Coil Winding
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Coilers
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
New England Butt Co., Providence, R. I.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Copper Wire Drawing and Rolling
Farrel-Birmingham Co., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Covering Wire
Sinfra Corp., Jersey City, N. J.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Cutting
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
National Machinery Exchange (Used), New York, N. Y.
F. B. Shuster Co., New Haven, Conn.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Enameling
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Extruding
John Robertson Co., Brooklyn, N. Y.
Royle, John & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Forming
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
Fidelity Machine Co., Philadelphia, Pa.
H. J. Ruesch Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sinfra Corporation, Jersey City, N. J.
Syncro Machine Co., Rahway, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting
Sinfra Corporation, Jersey City, N. J.

MACHINERY—Lead Encasing Presses, etc.
John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Magnet Wire
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY — Measuring Wire & Cable
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works Co., Chicago, Ill.
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Rubber Strip Covering
Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Royle, John, & Sons., Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y. Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
New England Butt Co., Providence, R. I.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY— Special — Combination Machine for Drawing, Cutting-to-length. Straightening and Reeling Bars from Coil in One Operation (Shumag Type)—
W. A. Schuyler, New York, N. Y.

MACHINERY—Spooling
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
Lewis Machine Co., The, Cleveland, O.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Swaging
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing Size of Wire
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y. Co., Phila., Pa.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.
Torrington Mfg. Co., The, Torrington, Conn.

MACHINERY—Welding Wire
Eisler Engineering Co., Inc., Newark, N. J.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Torrington Mfg. Co., The, Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
Aetna-Standard Engineering Co., Youngstown, O.
American Insulating Mach'y. Co., Phila., Pa.
Broden Construction Co., Cleveland, O.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.

WHERE TO BUY, Continued

W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Rahway, N. J.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Torrington Mfg. Co., The, Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Machine Co., Waterbury, Conn.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Rahway, N. J.

MACHINERY—Wood Screw
National Machinery Exchange (Used), New York, N. Y.

MACHINERY—Wrapping Wire
W. A. Schuyler, New York, N. Y.

MILLS—Tandem Rolling and Edging
Torrington Mfg. Co., The, Torrington, Conn.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.

NITROGEN GENERATORS—
Mahr Manufacturing Co., Minneapolis, Minn.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Insulating
E. W. Twitchell, Inc., Phila., Pa.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS
American Chemical Paint Co., Ambler, Pa.

PIPING AND FITTINGS—Acid Resistant
Duriron Co., Inc., The, Dayton, O.
Haveg Corp., Newark, Del.

POTS—Lead Melting
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

PYROMETERS—
Leeds & Northrup Co., Philadelphia, Pa.

RECORDERS—
Leeds & Northrup Co,, Philadelphia, Pa.

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., The, Torrington, Conn.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Hayward, R . B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Steel
Hayward, R . B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Takeoff
Mossberg Pressed Steel Corp., Attleboro, Mass.

REELS AND SPOOLS—Shipping and Shop
Hayward, R . B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Vulcanizing and Impregnating
Hayward, R . B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products, Co., Niles, O.

REELS—Wire Drawing
Hayward R. B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products, Co., Niles, O.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS—
Morrison Engineering Co., Cleveland, O.

RODS—Wire—Non-Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

ROLLS—
Farrel-Birmingham Co., Ansonia, Conn.

RUST PROOF COMPOUND—
American Lanolin Co., Lawrence, Mass.

SHEET—Steel
Youngstown Sheet & Tube Co., Youngstown, Ohio.

SKIN PROTECTOR—
Magnus Chemical Co., Garwood, N. J.

SOAPS—Industrial and Wire Drawing
Magnus Chemical Co., Garwood, N. J.

SPOOLS—Annealing and Wire Drawing
Hayward, R . B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Chicago, Ill.

SPOOLS—Shipping and Shop
Hayward, R . B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Chicago, Ill.

SPOOLS—Steel
Hayward, R . B. Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

STAMPINGS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass and Non Ferrous
Hudson Wire Co., Ossining, N. Y.

STRIP—Steel
Firth-Sterling Steel Co., McKeesport, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.

SWIFTS—Take-off
Apco Mossberg Corp., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TANKS—Pickling
Haveg Corp., Newark, Del.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS—
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS—
H. J. Ruesch Machine Co., Newark, N. J.

VALVES AND FITTINGS—Acid Proof
Duriron Co., The, Dayton, O.
Haveg Corp., Newark, Del.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y. Co., Phila., Pa.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Electric
Hudson Wire Co., Ossining, N. Y.

WIRE—Enameled For Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Co., Ossining, N. Y.

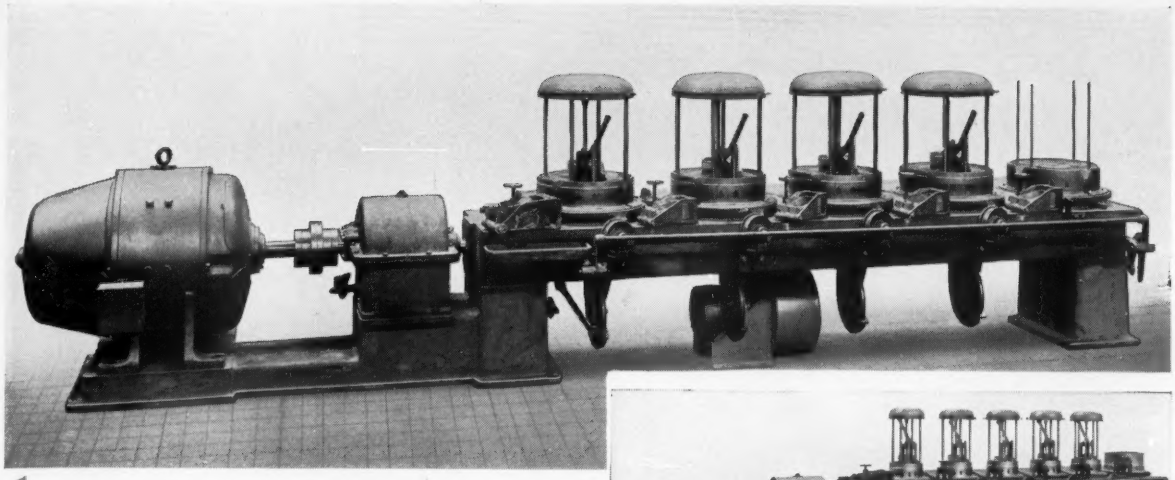
WIRE—Non Ferrous to Specification For Special Purposes
Hudson Wire Co., Ossining, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Bethlehem Steel Co., Bethlehem, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Steel—Also Coppered Steel——Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Cleveland, O.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE AND STRIP—Zinc
Metal Industry Works, Poland.
Platt Bros. & Co., The, Waterbury, Conn.

ZINC—Slab
St. Joseph Lead Co., Josephtown, Beaver County, Pa.



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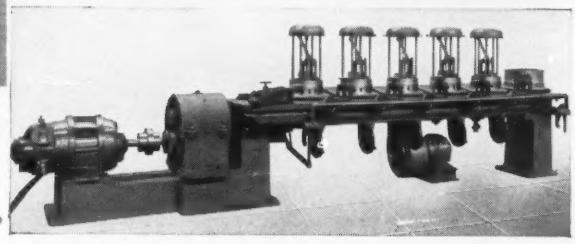


1

To Meet Your Needs..

EFFICIENT WIRE MILL EQUIPMENT

(1) Morgan-Connor Wire Machines, Types "B" & "C", for continuous drawing of wire. High speed, high production, completely air cooled, individual clutches for welding.

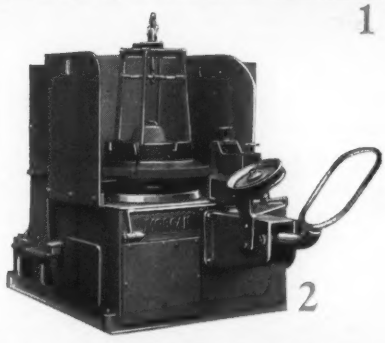
(2) Morgan Wire Block, a compact vertical spindle machine for single draft, or two drafts on double deck blocks.

(3) Morgan #105 Horizontal Bull Block for coarser sizes, affording highest production and economy through quicker stripping of coils.

(4) Morgan Take-Up Frames, ruggedly built for continuous service on patenting and galvanizing.

(5) Morgan Motor Driven Pointer for flexibility and ease of operation.

Other special and standard machines and accessories for the wire mill. Write for details.



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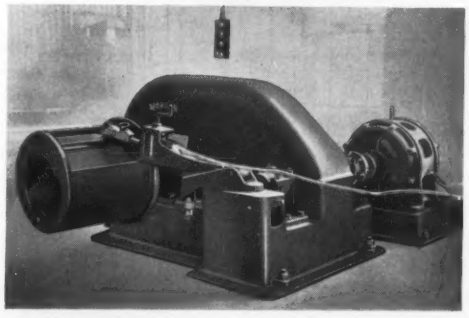

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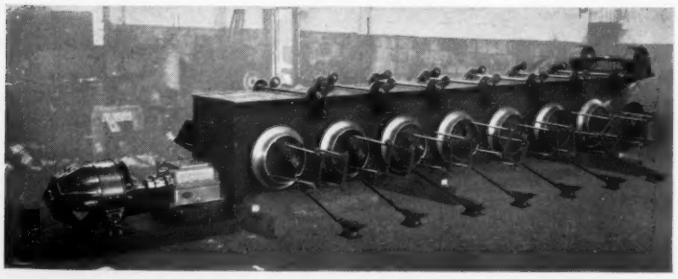

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4

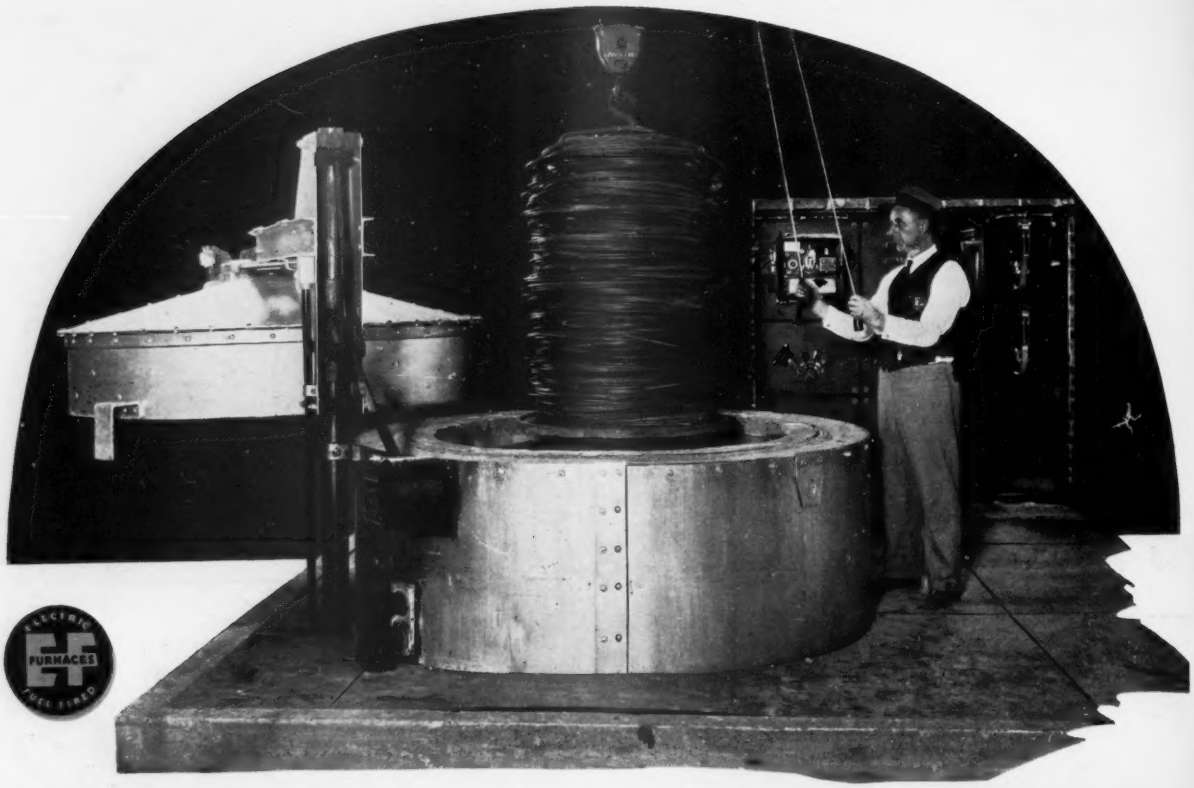
MORGAN
WORCESTER
ENGINEERS AND
MANUFACTURERS

MORGAN *Wire Drawing* MACHINERY

MORGAN CONSTRUCTION CO., WORCESTER, MASS., U. S. A.

W34

Sole European Representatives—Malmedie & Co., Dusseldorf, Germany



Allegheny-Ludlum Repeats . . . .

Installs Another E. F. Furnace at Dunkirk

For Annealing Alloy Rod Without Scale or Decarburization

The illustration above shows one unit of the original installation of circular pits we made in the Dunkirk plant of the Ludlum Steel Company back in 1929—for annealing alloy rod without scale or decarburization.

Recently we had the pleasure of installing another similar furnace in the Dunkirk plant for this same process—another "repeat order." The three furnaces are shown in the illustration at left—the new furnace in the background and the two original furnaces in the foreground—still operating daily after practically 10 years service.

Other interesting installations we have made in prominent steel plants include controlled atmosphere furnaces for bright annealing strip, wire, tubing, sheet and other products; furnaces for billet heating, annealing and normalizing bars and rod and for other products and processes.

We build gas fired, oil fired and electric furnaces---for any product, process or production. Permit us to submit proposals on *your* furnace requirements.

The Electric Furnace Co., Salem, Ohio

Gas Fired, Oil Fired and Electric Furnaces---For Any Process, Product or Production